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(Spring 2007-08)

## Lab Assignment #5

Due Lab #5

In this assignment, you will expand your operational space controller to use three kinds of potential fields to implement soft joint limits, follow a line, and avoid obstacles. Use dynamics in your controller.

### Potential Fields

1. **g\_jlimit** [*off/on*]: Implement a potential field controller to create soft joint limits. Use the default joint limits that appear in the settings tab (see handout 4). **g\_jlimit** boolean variable specifies when to apply your joint limit avoidance control. **PostprocessControl()** is called every servo loop just before the control law torque is sent to the robot.
2. **g\_qo** : Sets the minimum distance to apply the joint limit potential fields.  
Default values:  $g\_qo = (5^\circ 5^\circ 5^\circ 5^\circ 5^\circ 5^\circ)^T$
3. **g\_kj** : Sets the gains for the joint limit potential field controller.  
Default values:  $g\_kj = (.1.1.1.1.1.1)^T$
4. Plot motion as a joint approaches its limit. Check if oscillations occur before settling. Plot potential field torque to show the repulsion effect. Make sure the torque is zero at the minimum distance **g\_qo**.
5. **lineControl**: Class *Line* is defined in cs225.h. Lines can be specified interactively from the settings tab and stored in **g\_line**. The end-effector should move towards the line using a potential field. It is important to note that once the end-effector is on the line, it should be entirely free to move along the line if we disturb it manually.
6. Plot motion along the **g\_line**.
7. **g\_obstacles** : Defines an array of obstacles each at  $(x, y, z)$  with a radius  $r$  in base frame  $\{0\}$ . There will never be more than  $g\_numObstacles$  obstacles defined at a time (typically less than five).
8. **pfmoveControl** [ $x\ y\ z\ \alpha, \beta, \gamma$ ] : Use a potential field controller to move to position  $(x, y, z, \alpha, \beta, \gamma)$  avoiding all obstacles defined by **g\_obstacles**. Use the end-effector point and elbow in the potential field controller. Ideally, you would want to find a point on the robot closest to the obstacle but it's difficult since it changes and you do not have access to the geometric model of the robot.
9. **g\_eta**: Sets the gain for the potential field controllers.  
Default value:  $g\_eta = .01$ .
10. Plot the motion while avoiding an obstacle.

Make sure you put enough comments so that we can understand what you're doing!

Submit a report describing what you learned in the lab.