Homework 1

**Points to Note:**

1. Have tried out 3 approaches for jacobian control – Jacobian Transpose Method, Pseudo Inverse Basic Method (Lecture Slide 10) and Pseudo Inverse with Explicit Optimization Criterion (Lecture Slide 13).
2. Found the Pseudo Inverse Method with Explicit Optimization Criterion as the best among the three approaches, in-terms of the speed of convergence to the target position and orientation and in-terms of faster accuracy.
3. So, all the homework executables will execute the pseudo inverse method with explicit optimization criterion (lecture slide 13).
4. For homework part 4, it will take up to 3-4 minutes according to clock time and around 1500-1700 according to Mujoco time to finish the workflow and align to the target marker. It achieves a zero error perfect alignment and some of the pictures captured with the perfect alignment are also included in the homework zip.
5. The executables were built with Visual Studio 2013.

**Impact of Alpha on the Jacobian control methods:**

Alpha is a parameter governing the rate of convergence in both the methods. It can be thought of as the rate of gradient descent to reach a target. Doing the experiments, I found that lower alpha means slower progress towards the target. While in some situations, having higher alpha to achieve faster convergence to the target might make sense, there are situations where the alpha has to be kept reasonably low to make sure not to overshoot the target in any one step and avoid wobbling effects, which might end up breaking the workflow in certain situations. For example, overshooting with higher alpha could break the process while positioning to pick up an object like in homework part 4.

**Jacobian Transpose vs Pseudo Inverse Method:**

Pseudo Inverse method is high Number of computations (in terms of number of multiplications and additions) than the Jacobian Transpose method. And the trajectory of the pseudo inverse method appears to be on the shortest path to the target while the same cannot be said about the trajectory of jacobian transpose method. Pseudo Inverse is many times faster to reach the target than jacobian transpose method, for the same value of Alpha (the rate of convergence to target).