CSE4421: Lab 3

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Due: Before 11:59PM Sun Feb 10, 2013

Note: I will check your answers for steps 1 and 3 if you ask.

1. Derive the table of Denavit-Hartenberg (DH) parameters for the A150 robot using the frame placements shown in Figure 1. Links 1–3 all have a length of 10 inches. Link 4 can be treated as a link of length 0 inches. The distance between o_4 and o_5 is 2 inches.

2. Implement a Matlab function that computes the Denavit-Hartenberg transformation matrix given vectors of DH values a, α, d, and θ. The function signature should be:

   ```
   function T = dh(a, alpha, d, theta)
   ```

   You can check that your function gives results that are consistent with the A150 simulator by plugging in appropriate DH values for the A150 arm.

3. Derive the analytic form of the matrix T_5^3; i.e., derive the elements of the 4×4 matrix.

4. Solve the inverse kinematics problem for the wrist; i.e., given T_5^3 solve for the values of θ_4 and θ_5. Implement a Matlab function that computes the inverse kinematics of the wrist. The function signature should be:

   ```
   function theta45 = invwrist(T35)
   ```

   where `theta45` is the vector $[\theta_4 \ \ \theta_5]$ and `T35` is the matrix T_5^3.

5. Implement a Matlab function that finds the location of o_c^0, the wrist center relative to frame $\{0\}$, given T_5^0, the pose of frame $\{5\}$ relative to frame $\{0\}$. The function signature should be:

   ```
   function oc = wristcenter(T05)
   ```

   where `oc` is the wrist center location o_c^0 and `T05` is the matrix T_5^0.

Submit your Matlab files using the command

```
submit 4421 L3 dh.m invwrist.m wristcenter.m
```

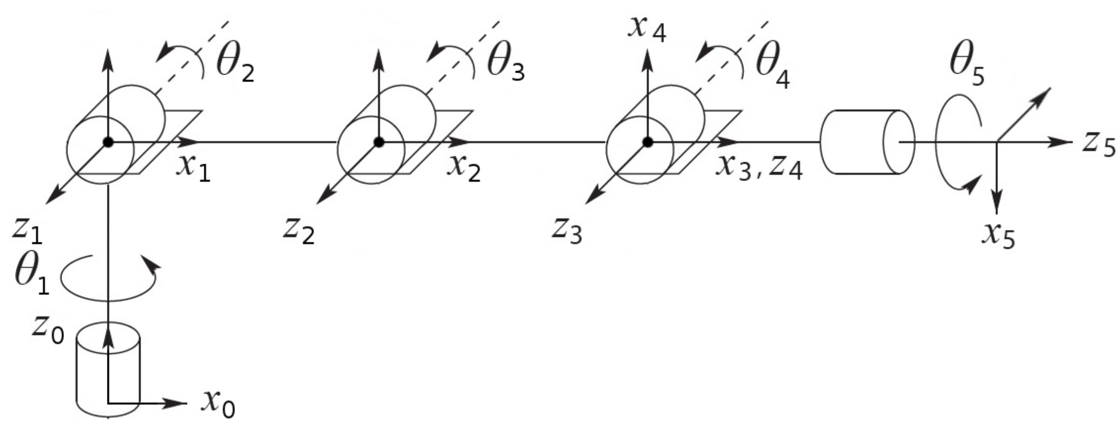

Figure 1: Denavit-Hartenberg frame placement for the A150 and A255 robots.

Joint variable	Range
θ_1	$-175°$ to $175°$
θ_2	$0°$ to $110°$
θ_3	$-130°$ to $0°$
θ_4	$-110°$ to $110°$
θ_5	$-180°$ to $180°$

Table 1: The joint variable ranges in the Denavit-Hartenberg convention.