Robotics Examination (2017-Fall semester) 1/23/2018 (4th period)

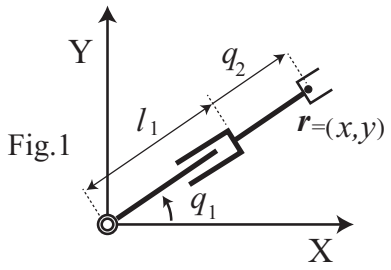

Fig.1

(1) For a planar 2-D.O.F. robotic arm in horizontal plane,
(1-1) calculate the tip position vector $\boldsymbol{r} = [x, y]^T$.
(1-2) Calculate $\dot{x}, \dot{y}$ and show $\dot{\boldsymbol{r}} = J(\boldsymbol{q})\dot{\boldsymbol{q}}$.

(1-3) When the force $\boldsymbol{f} = [f_x, f_y]^T$ is added to the hand part, calculate the corresponding torque/force $\boldsymbol{\tau} = [\tau_1, \tau_2]^T$ to hold the added force.

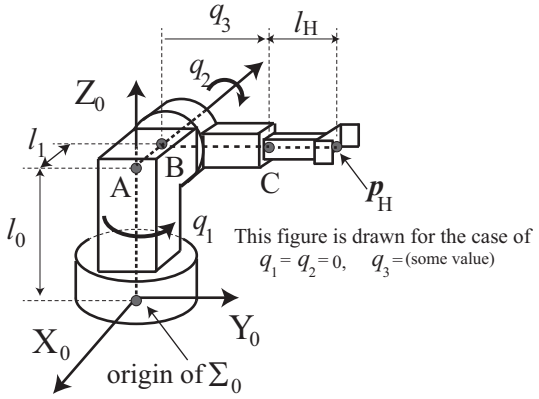

Fig. 2

(2) Answer the following questions on Fig. 2.
(2-1) Show a figure of relationship for the condinate frame $\Sigma_0 \sim \Sigma_3$ including the points A $\sim$ C.
(2-2) Find the Denaviet-Hartenberg parameters for the robot. Note that the origin of Σ_0 is specified, plus sign represents the positive direction and follow the recommendations in the textbook on some free setting of coordinate axes.
(2-3) How do you represents the vector ${}^0\boldsymbol{p}_H$ in Σ_0 using homogenous transfer matrix ${}^0T_3$. Where you do not need to show the actual elements of ${}^0T_3$.

(3) Sketch the C-Free region by hatched area in C space for the case of a two-link robotic arm and an obstacle of a seperate sheet.