ECE 470: Introduction to Robotics Homework 7

1) In Canny edge detection algorithm,
   a) What happens if Gaussian filter is not applied in the first step?
   b) Which steps cause the thinning effect of the edge? Explain.
   c) What happens of the first and second thresholds are very close to each other in the hysteresis thresholding step?

(6 Points)

2) In trying to detect lines represented by equation $[y\ |1]^T = [A\ |B]\ [x\ |1]^T$ in the cartesian space with coordinates (x, y), *we transform the points* (x_i,y_i) *to a parameter space* (A, B).
   a) How will a point (x_i,y_i) look like when transformed to the (A, B) space? *(1 Points)*
   b) How is a point on the (A, B) space represented in the (x,y) space? *(1 Points)*
   c) Describe graphically how collinear points P1 to P4 can be identified in Fig. 1? *(4 Points)*
   d) What will be the problem in detecting lines in Fig. 1 using (A, B) as parameter space? *(2 Points)*
   e) Describe a method you learn in class that could deal with the problem. *(6 Points)*

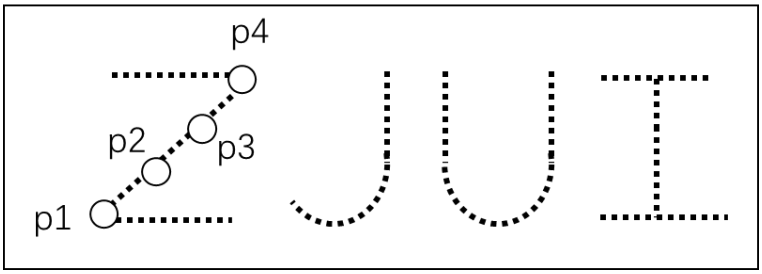

Fig. 2

3) Fig. 2 shows the orientation and position of a camera frame {C} with respect to the world reference frame {W}.

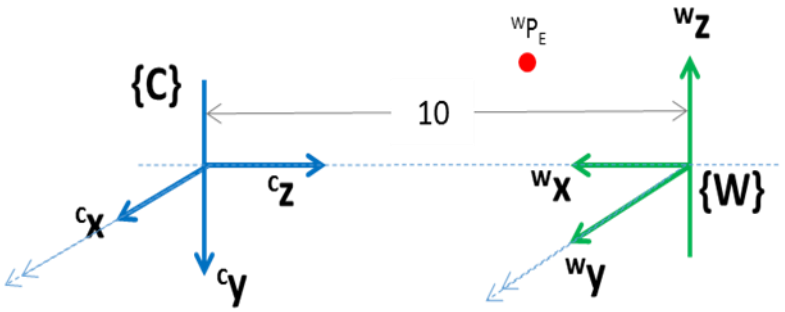

Fig. 2

a) Write down the rotation matrix representing the orientation of the world frame {C} with respect to the camera frame {W} i.e. ${}^{W}R_{C}$. *(1 Points)*

b) Write down the 3x4 extrinsic matrix of the camera. *(1 Points)*

c) A point referenced from the world frame $(15, 30, 15)^{T}$ is observed to have image coordinates (600, 300). Given that *fx=fy* and *ic=jc* and assuming skew coefficient a=0, solve for the intrinsic camera matrix

$$K = \begin{bmatrix} fx & a & ic \\ 0 & fy & jc \\ 0 & 0 & 1 \end{bmatrix}$$

(8 Points)