E190Q Midterm Practice questions 2014

1. Figure A has more confidence in range compared to orientation. Figure B has the opposite. Figure A could be a sonar with a large sensor cone, while Figure B could be monocular vision that uses object size to determine range, but has good angular accuracy.

2. The math for stereo vision can be used here. First, do the easy thing and assume that y1 = y2. Now the math is just like the example in notes the b = abs(x2-x1). Using this strategy, you can use stereo vision math to obtain the [x y z] of the target. I would expect to see all equations on the solution.

   Given the situation where the robots have different y values, I would let b = sqrt((x2-x1)^2 + y2-y1)^2). In this case, the stereo vision coordinate frame would be aligned with the line between the two robots. Since the cameras are shifted with respect to each other, all pixel coordinates must be rotated to align them with this new coordinate system. The rotation is through the angle beta = atan2(y2-y1,x2-x1). Once the x,y,z of the target is obtained in this coordinate system using stereo vision equations, the x,y,z must be rotated beta back into the global reference frame.

3. This is directly from notes.

4. a) e = x_des - (x_0 – x_1)

   b) e_dot = 0 – (v_0 – v_1)

   c) v_1 = v_0 + Ke

   d) e_dot = -(v_0 – v_1) = -(v_0 – (v_0 + Ke)) = Ke

   therefore

   e_dot = Ke

   This is stable for K < 0 since e = e_0 exp(Kt)

5. This is an instance of markov localization. For the prediction step, equations can be written in the form:

   p(l_t' = 1) = f11*p(l_t-1=1) + f21*p(l_t-1=2) + f31*p(l_t-1=3) + f41*p(l_t-1=4)

   etc.

For the correction step, use Baye’s rule

$$p(l_t = 1) = p(z_t \mid l_t'=1) * p(l_t'=1) / p(z_t)$$

In this case, you should suggest a good sensor model for the laser scanner (e.g. the conditional probability can be represented as an experimentally determined normal distribution). The denominator can be obtained through normalization as discussed in class.

6. I don’t want to give this one away…