CSE 571: Probabilistic Robotics
Assignment #2
Assigned: January 12, 2012
Due: Thursday, January 26 (noon, start of class)

Problem:

1. Let X and Y denote two random variables that are jointly Gaussian:

$$\begin{aligned} p(x,y) &= \mathcal{N}(\mu^*, \Sigma) \\ &= \det(2\pi\Sigma)^{-\frac{1}{2}} \exp\left\{-\frac{1}{2}\left((x,y)^T - \mu^*\right)^T \Sigma^{-1}\left((x,y)^T - \mu^*\right)\right\} , \end{aligned}$$

   where $\mu^* = (\mu_x^*, \mu_y^*)^T$ and $\Sigma = \begin{pmatrix} \sigma_x^2 & \sigma_{xy}^2 \\ \sigma_{xy}^2 & \sigma_y^2 \end{pmatrix}$ are the mean and covariance, respectively. Show that conditioning on Y results in a Gaussian over X:

$$\begin{aligned} p(x \mid y) &= \mathcal{N}(\mu, \sigma^2) \\ &= \left(2\pi\sigma^2\right)^{-\frac{1}{2}} \exp\left\{-\frac{1}{2}\frac{(x-\mu)^2}{\sigma^2}\right\} \end{aligned}$$

   with $\mu = \mu_x^* + \frac{\sigma_{xy}^2}{\sigma_y^2}(y - \mu_y^*)$ and $\sigma^2 = \sigma_x^2 - \frac{\sigma_{xy}^4}{\sigma_y^2}$.

2. Implement landmark based robot localization using an EKF and a particle filter. You will turn in your code and a writeup analyzing its performance. For the matlab/octave code package and a more detailed description of the programming part of the assignment and the requirements of the writeup, see the link from the course website calendar.