ME8135 - State Estimation - Assignment 1.1

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1 Question 2

f) Repeat part e), for the following values:

$$\mathbf{x} = \begin{bmatrix} 1m \\ 0.5^\circ \end{bmatrix}, \mathbf{\Sigma} = \begin{bmatrix} 0.01 & 0 \\ 0 & 0.005 \end{bmatrix} \tag{6}$$

$$\mathbf{x} = \begin{bmatrix} 1m \\ 0.5^\circ \end{bmatrix}, \mathbf{\Sigma} = \begin{bmatrix} 0.01 & 0 \\ 0 & 0.1 \end{bmatrix} \tag{7}$$

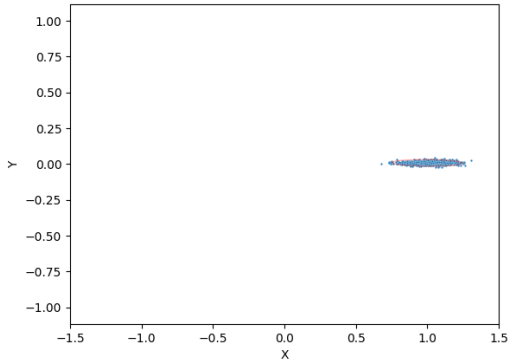
$$\mathbf{x} = \begin{bmatrix} 1m \\ 0.5^\circ \end{bmatrix}, \mathbf{\Sigma} = \begin{bmatrix} 0.01 & 0 \\ 0 & 0.5 \end{bmatrix} \tag{8}$$

$$\mathbf{x} = \begin{bmatrix} 1m \\ 0.5^\circ \end{bmatrix}, \mathbf{\Sigma} = \begin{bmatrix} 0.01 & 0 \\ 0 & 1 \end{bmatrix} \tag{9}$$

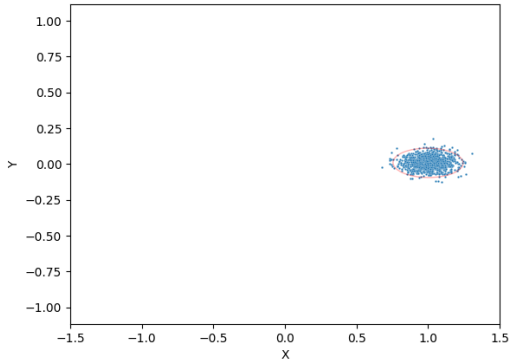
The variance of $\mathbf{x}_1$, i.e. $\sigma^2_{\rho\rho}$, is fixed so we expect the points to fall around a distance of 1m from the origin. Meanwhile the variance of $\mathbf{x}_2$, i.e. $\sigma^2_{\theta\theta}$ represents the uncertainty in the polar angle readings. As the variance increases we would expect the readings to become spread out along the circle.

As a rough example, in equation (9), $\sigma^2_{\theta\theta} = 1$ degrees$^2 \approx 0.0174$ radians^2. The standard deviation is $\sigma_{\theta\theta} \approx 0.417$ radians ≈ 23.9 degrees. This can be verified by visual inspection of Figure 1(d). Similar reasoning can be applied to the other variances.

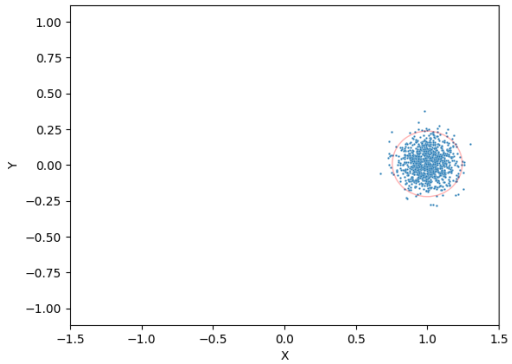
Note that the random seed is fixed in all plots of Figure 1.



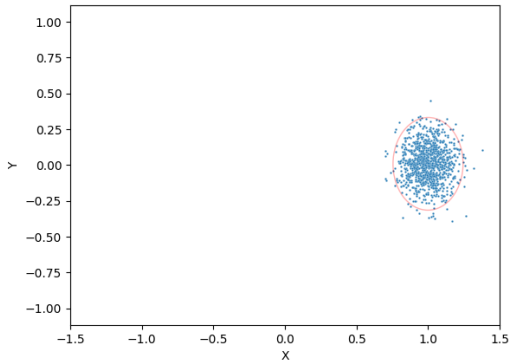
(a) $\sigma^2_{\theta\theta} = 0.005$.



(b) $\sigma^2_{\theta\theta} = 0.1$.



(c) $\sigma^2_{\theta\theta} = 0.5$.



(d) $\sigma^2_{\theta\theta} = 1$.

Figure 1: Plots of the transformed distributions.