Assignment 5

In this Exercise, Unscented Transform has to be implemented using two given functions named *compute_sigma_points* and *recover_gaussian*. The idea of the unscented transform is to choose a set of points from the Gaussian distribution (similar to the real world) and convert them into another gaussian distribution using a non-linear transform g(x). First of all, it can be done by computing the sigma points but however it is not a guassian distribution anymore after the transform. Then try to recover the Gaussian by computing the μ and ε from the obtained transform. Later on, the extended kalman filter can linearize the newly transform gaussian distribution (this part is beyond the scope of this assignment 5). The initial distribution (μ and ε) and initialized parameters (n, k, λ and β) have been already given. The sigma points ℵ are calculated by

$$\aleph_0 = \mu$$

$$\aleph_i = \mu + \sqrt{(n+\lambda)\varepsilon} \qquad \aleph_{i-n} = \mu - \sqrt{(n+\lambda)\varepsilon}$$

Once the sigma points is computed, the transform can be applied on it. The transform can be either linear or non-linear functions. The weights has to be assigned for each sigma points as

$$w_m^0 = \frac{\lambda}{\mathrm{n} + \lambda} \qquad w_c^0 = w_m^0 + (1 - \sigma^2 + \beta) \quad w_m^i = w_c^i = \frac{\lambda}{2(\mathrm{n} + \lambda)}$$

Therefore the equations for recovering the gaussian are

$$\mu = \sum_{i=0}^{2n} w_m^i * g(\aleph^i)$$

$$\varepsilon = \sum_{i=0}^{2n} w_c^i * g(\aleph^i - \mu) * g(\aleph^i - \mu)^T$$

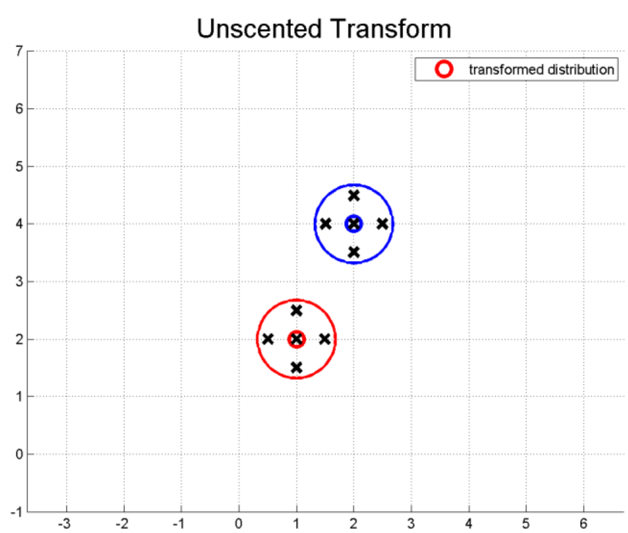

Figure 1: Linear Transform Function

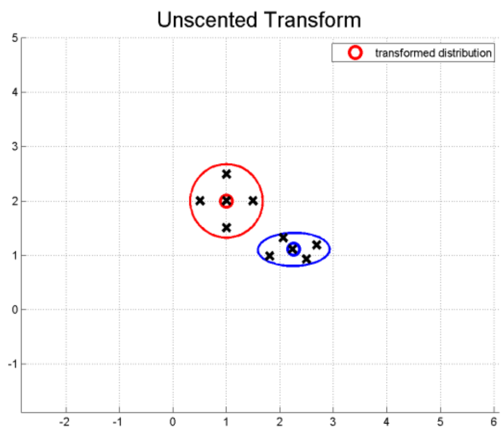

Figure 2: Polar Co-ordinates Transform

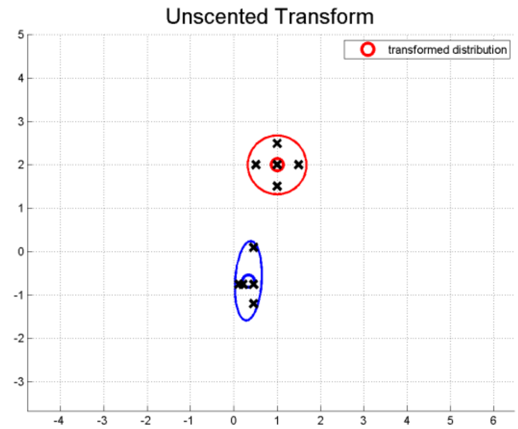

Figure 3: Non-linear Transform

In Figure 1, the sigma points are transformed using the simple linear equation so we can notice that the entire transform just moved a just little according to the linear equation. In the figure 2 and 3, the transform is done by non-linear equation so that the eigen values changes accordingly which leads to the ellipse shaped guassian distribution.

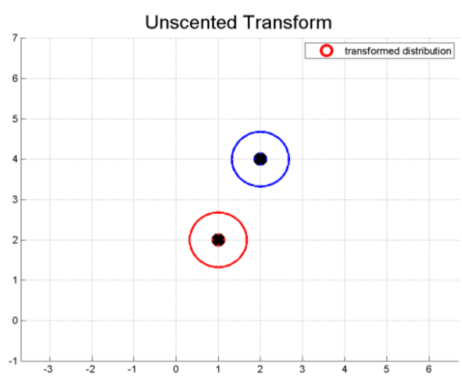

Figure 4: alpha = 0.1

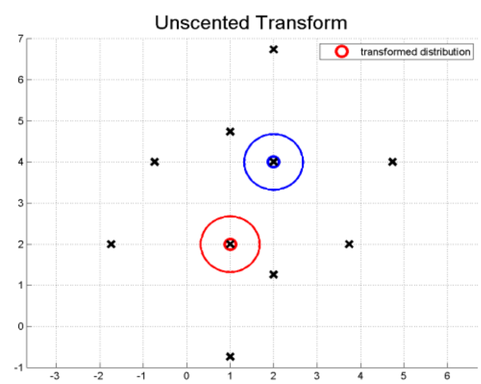

Figure 5: alpha = 5

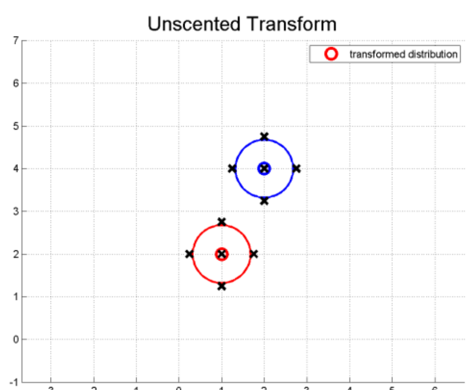

Figure 6: kappa = 5

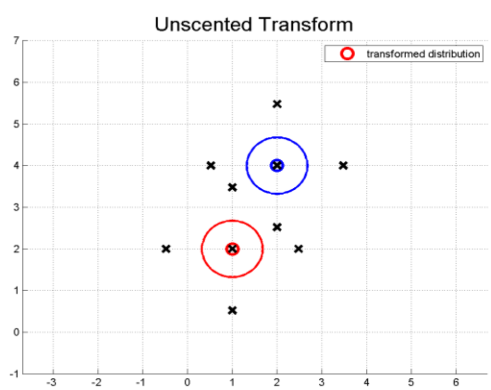

Figure 7: kappa = 25