Assignment 5 - Unscented transform framework

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Course - Robotic Mapping

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1 Summary

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 σ 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^σ) and initialized parameters (n, k, λ and β) have been already given.

(a) Transform: Linear Function (x=1, y=2)   (b) Transform: Linear Function (x=1, y=-2.5)

Figure 1: Test Cases

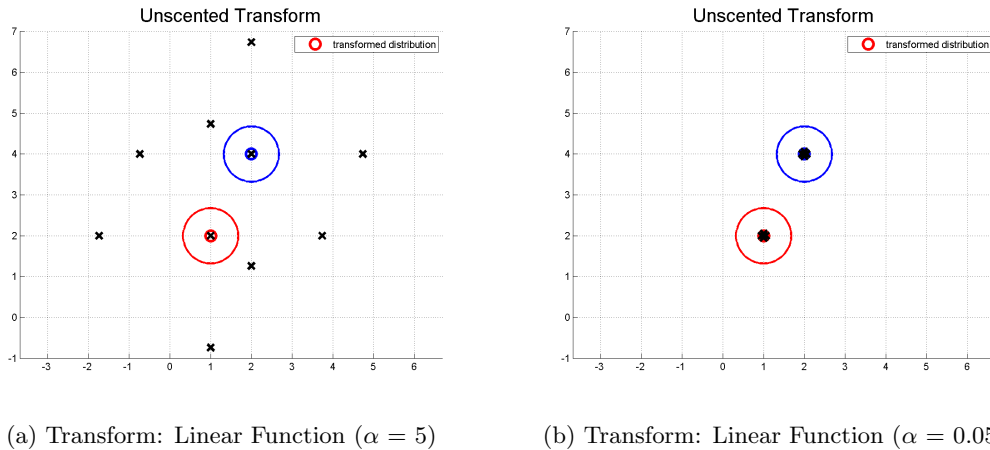(a) Transform: Linear Function ($\alpha = 5$)   (b) Transform: Linear Function ($\alpha = 0.05$)
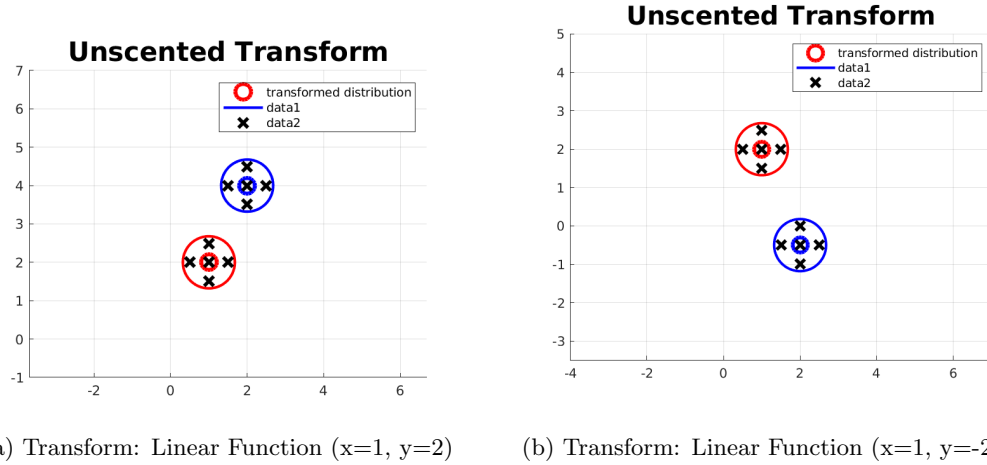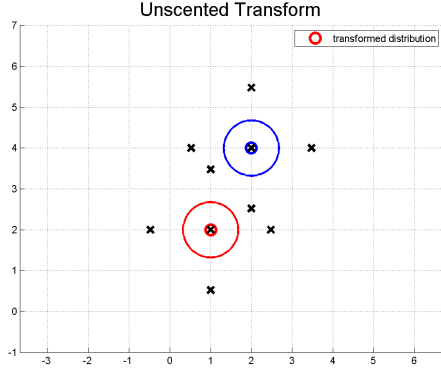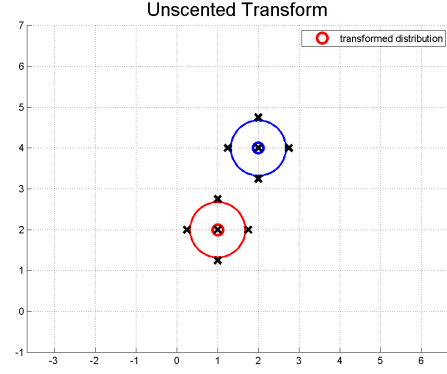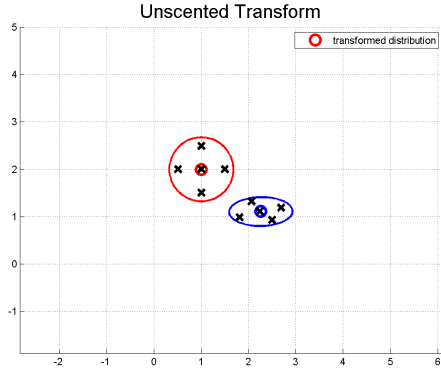
Figure 2: Test Cases

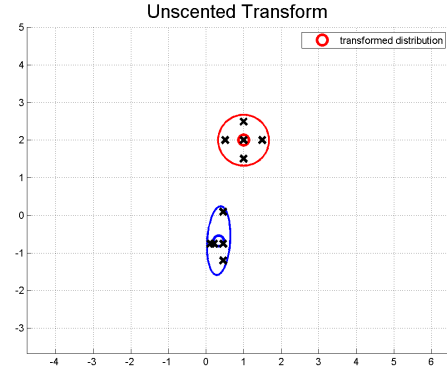(a) Transform: Linear Function ($\kappa = 25.0$) (b) Transform: Linear Function ($\kappa = 5.0$)

Figure 3: Test Cases

(a) Transform: Non-Linear Function (Equation 1) (b) Transform: Non-Linear Function (Equation 2)

Figure 4: Test Cases

The linear transform function will give constant shift in x and y position as in the figure 1a and 1b. When α is increased, then the sigma points will spread out of the distribution (fig 2a). On the other hand, if the α is very much reduced then all the points will almost on the μ value (fig 2b). This is the same case applicable in the increase and decrease of κ value as well (fig 3a and 3b). When two different non-linear equations are applied as a transform, then the co-variance turned into an ellipse from circle. And the sigma points will still spread within the ellipse region with the standard initial values as in the figure 4a and 4b.