Interference phenomena

The probability equation of QGMM is that

$$P(p_i|\alpha_k,\theta_k)=\left|\psi(p_i|\alpha_k,\theta_k)\right|^2$$
$$=\sum_{k=1}^{K}\left[\frac{\alpha_k}{\sqrt{Z_k}}\exp\left(\frac{-1}{4}(p_i-\mu_k)C_k^{-1}(p_i-\mu_k)\right)\sum_{l=1}^{K}\frac{\alpha_l^*}{\sqrt{Z_l}}\cos\phi_{l,k}(p_i)\exp\left(\frac{-1}{4}(p_i-\mu_l)C_l^{-1}(p_i-\mu_l)\right)\right]$$

At the above equation, due to $\cos_{l,k}$, we can observe the quantum interference phenomena, not present the classical GMM.

Therefore, in this experiment, we'll see the interference phenomena in 3D plotted images.

Aim

The aim of this experiment is to visualize the interference phenomena in 3D plotted images changing the value of $\cos_{l,k}$ arbitrarily and check if the shape of probability is same with the classical GMM when phi is equal 90.

Experiments

The number of data is 150 from -3.8 to 3.8.

means1 = [-1.5, -1.5]
means2 = [1.5, 1.5]

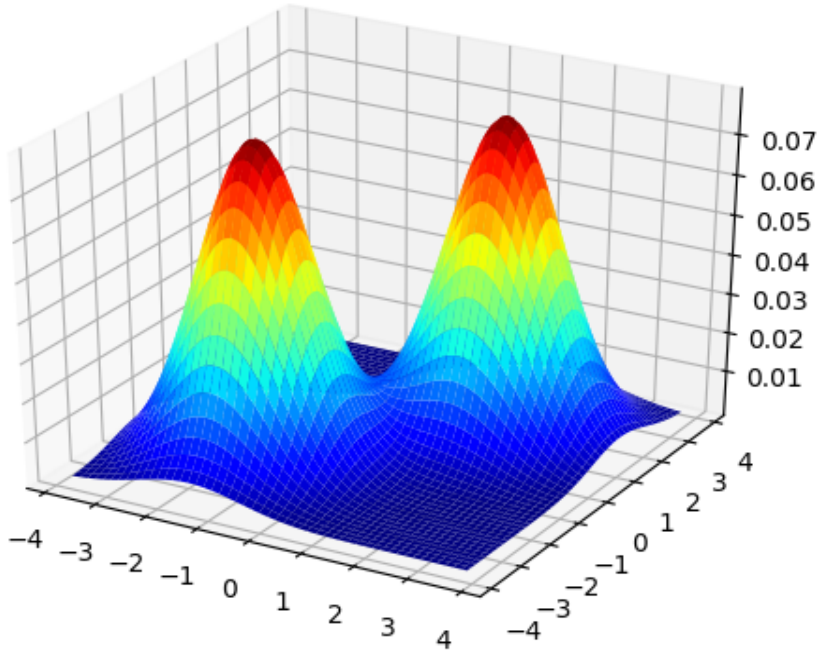
covs1 = covs2 = [[1, 0],
[0, 1]]

The range of phi is from 0 to 180.

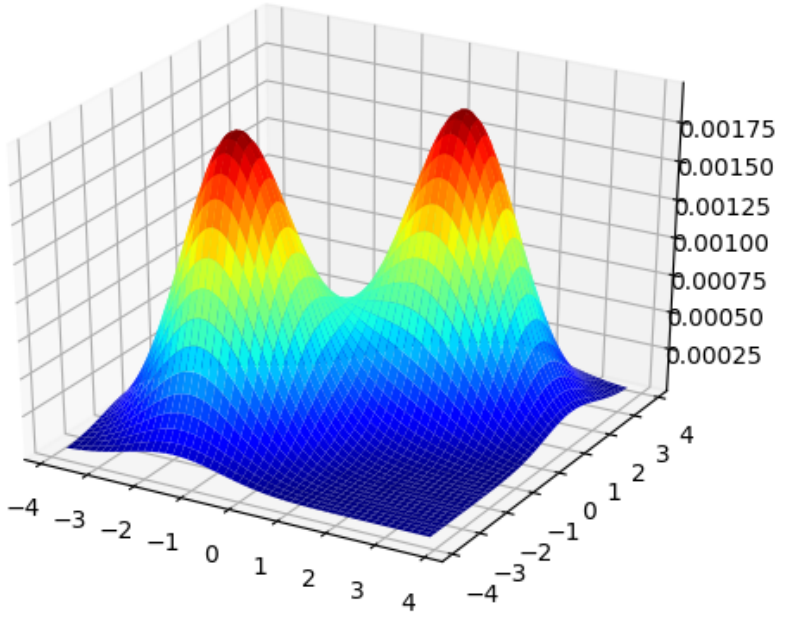
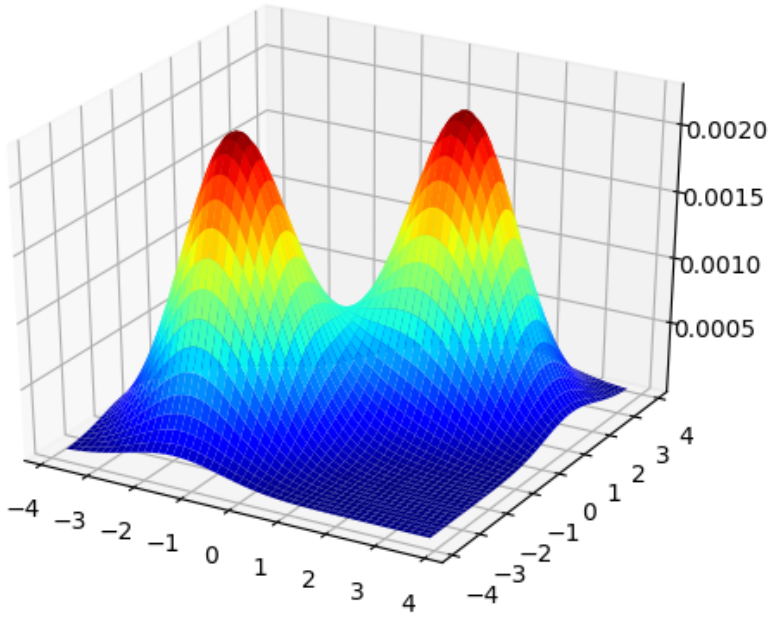
Results

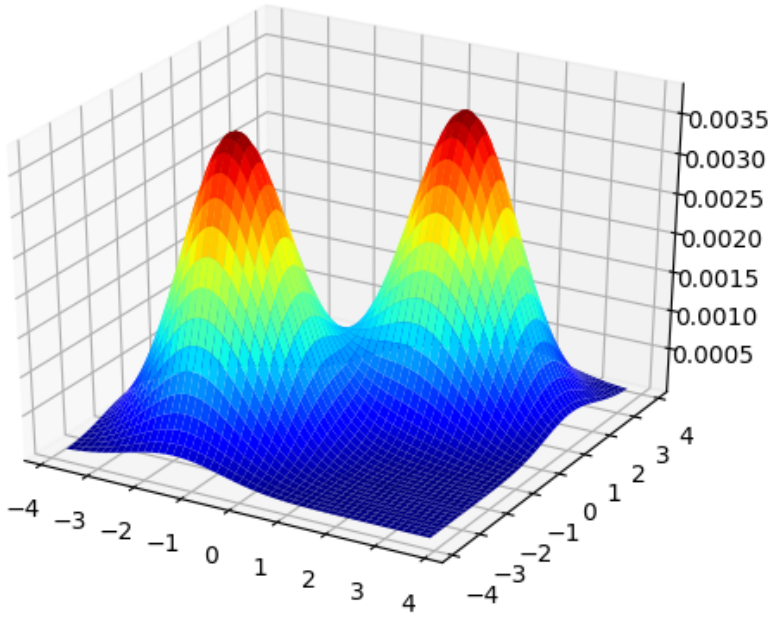
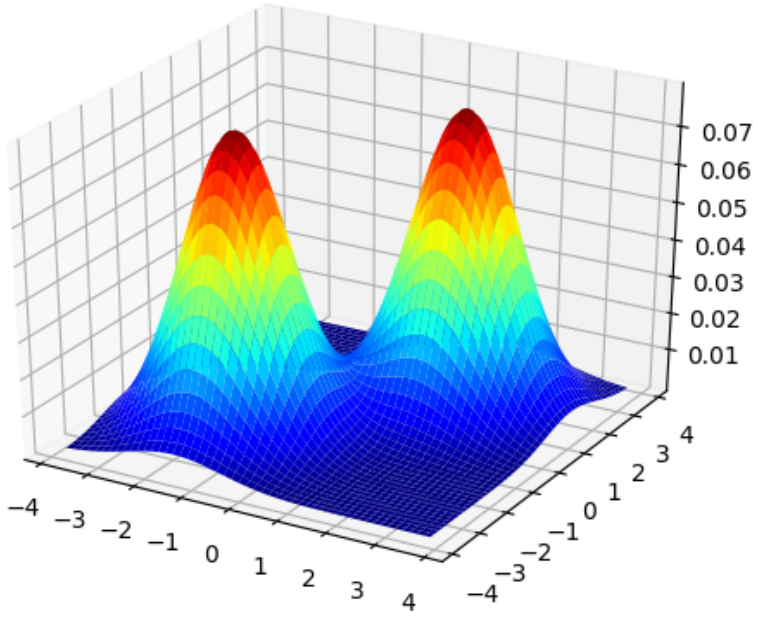
Data/Images/Interference phenomena

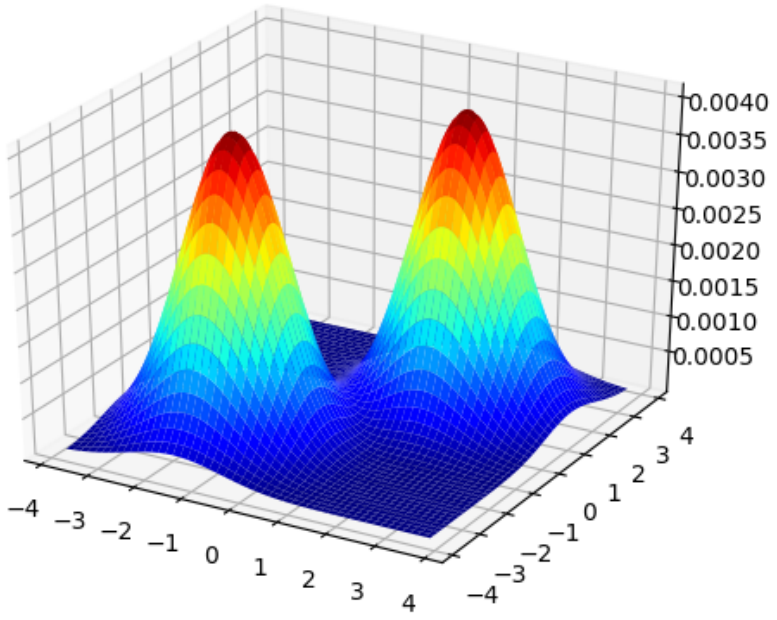
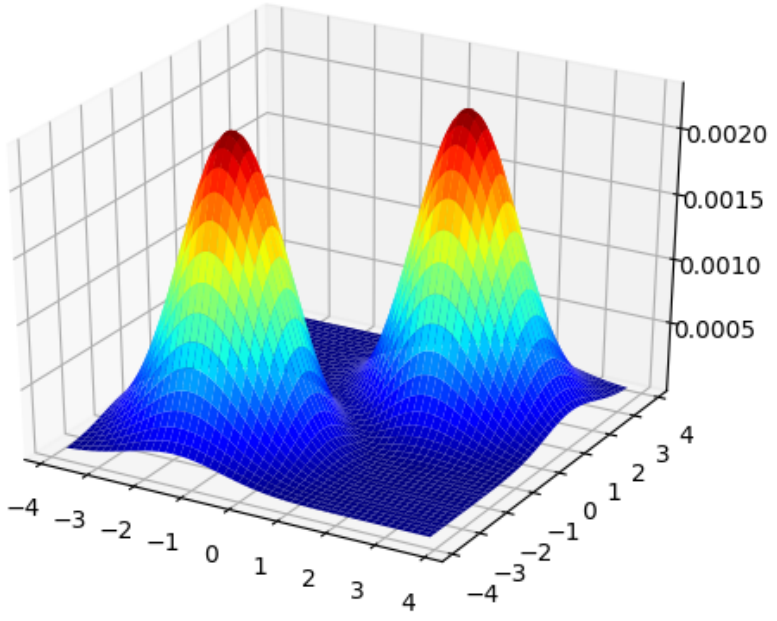
The classical GMM is

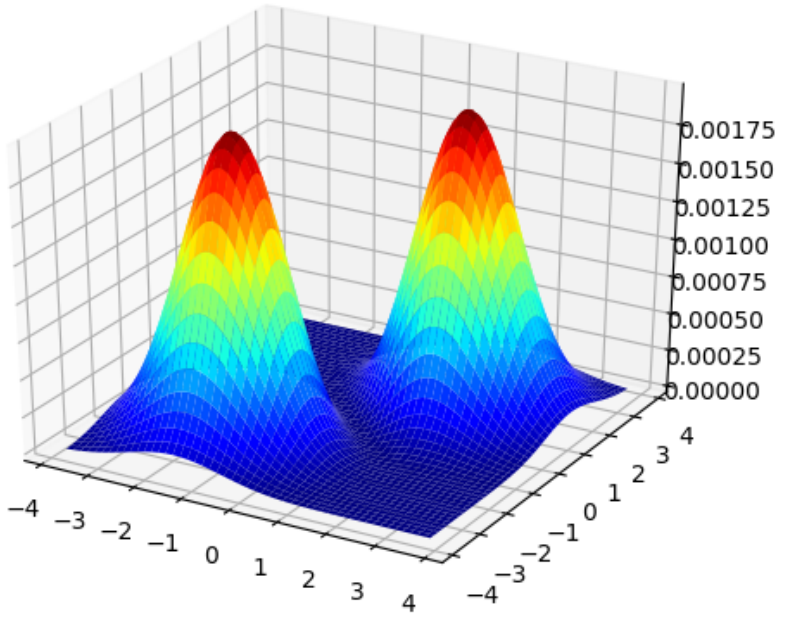


These are some of result images of QGMM.

Phi	Images
0	
30	

60	 0.0035 0.0030 0.0025 0.0020 0.0015 0.0010 0.0005 −4 −3 −2 −1 0 1 2 3 4 −4 −3 −2 −1 0 1 2 3 4
90	 0.07 0.06 0.05 0.04 0.03 0.02 0.01 −4 −3 −2 −1 0 1 2 3 4 −4 −3 −2 −1 0 1 2 3 4

120	 0.0040 0.0035 0.0030 0.0025 0.0020 0.0015 0.0010 0.0005 −4 −3 −2 −1 0 1 2 3 4 −4 −3 −2 −1 0 1 2 3 4
150	 0.0020 0.0015 0.0010 0.0005 −4 −3 −2 −1 0 1 2 3 4 −4 −3 −2 −1 0 1 2 3 4

180	

From the above images, we can see the interference phenomena and find QGMM is same with the classical GMM when the phi is 90.

Conclusions

In this experiment, we looked into the interference phenomena and it is interesting because it is property that only QGMM has.

Also, we will check the impact of it on the performance side in the another experiment.