$$\int (\alpha_1^{\ 2} G_1^{\ 2} + \alpha_2^{\ 2} G_2^{\ 2} + 2\alpha_1 \alpha_2 \cos\psi G_1 G_2)\, dp$$

$$= \int \alpha_1^{\ 2} G_1^{\ 2} + \int \alpha_2^{\ 2} G_2^{\ 2} + \int 2\alpha_1 \alpha_2 \cos\psi G_1 G_2\, dp$$

$$= \alpha_1^{\ 2} \int G_1^{\ 2} + \alpha_2^{\ 2} \int G_2^{\ 2} + 2\alpha_1 \alpha_2 \int \cos\psi G_1 G_2\, dp$$

$$= \alpha_1^{\ 2} + \alpha_2^{\ 2} + 2\alpha_1 \alpha_2 \int \cos\psi G_1 G_2\, dp$$

where $G = \frac{1}{(2\pi)^{D/4} |C_k|^{1/4}} \exp(-\frac{1}{4}(p - \mu_k)^T C_k^{\ -1} (p - \mu_k))$

I've had a trouble in integrating $\int \cos\psi\, G_1 G_2\, dp$.

By studying https://en.wikipedia.org/wiki/Gaussian_integral that you link, I became aware of the Gaussian integral.

By now, I calculated below by refering
https://en.wikipedia.org/wiki/Common_integrals_in_quantum_field_theory

$$\int G_k^{\ 2} = \int G_k\, dx \int G_k\, dy = \sqrt[2]{\frac{(2\pi)^d}{|C_k|}}$$

Thus

$$\int G_k = \sqrt[4]{\frac{(2\pi)^d}{|C_k|}}$$

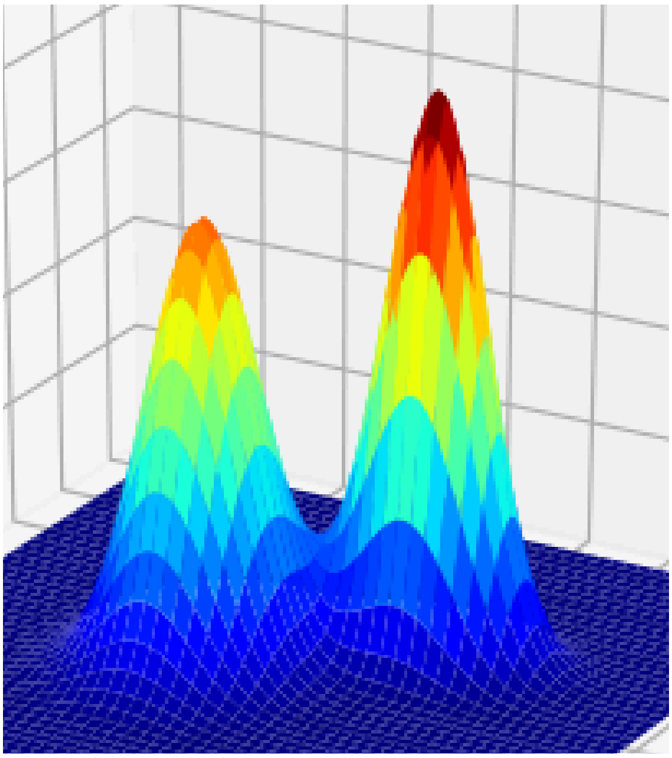
But the calculating $\int \cos\psi$ is tricky, as the initial values didn't present on the paper.

I'll spend this weekend on thinking about workaround.

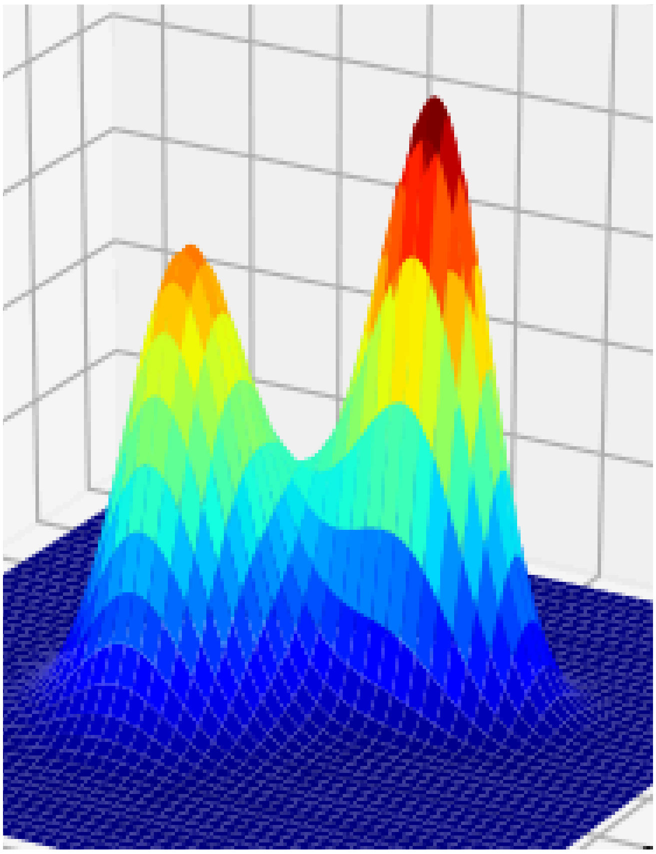
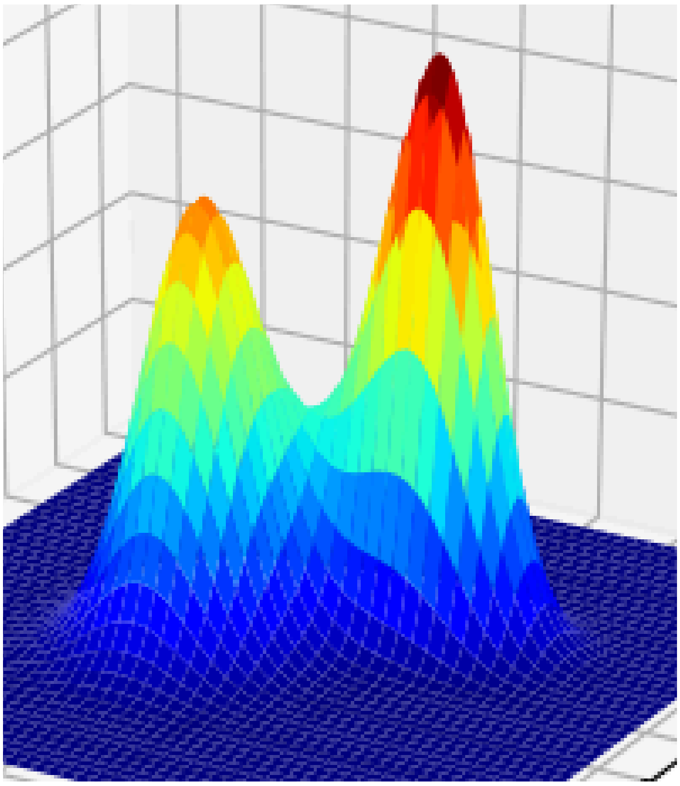
Sorry for the delay…

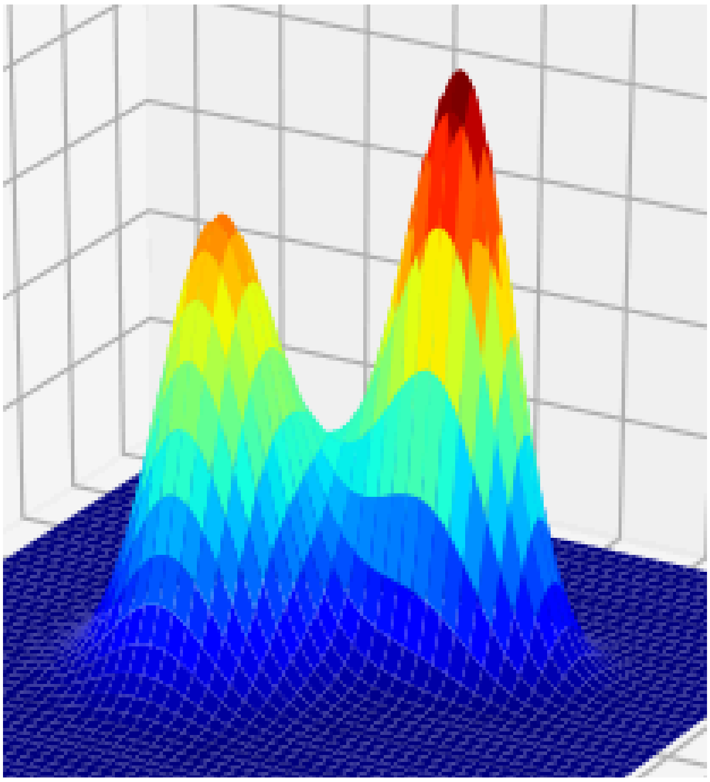
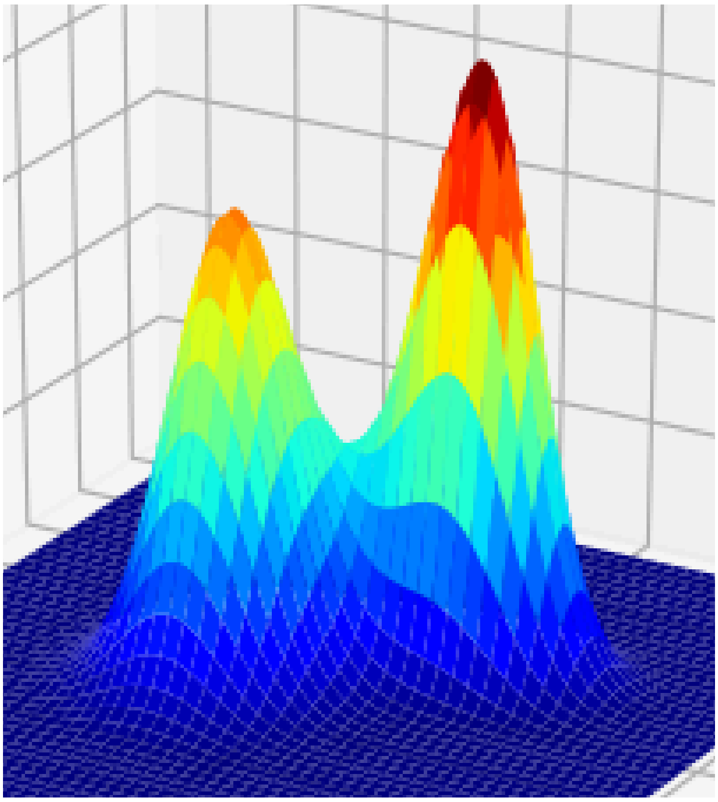
Classical GMM

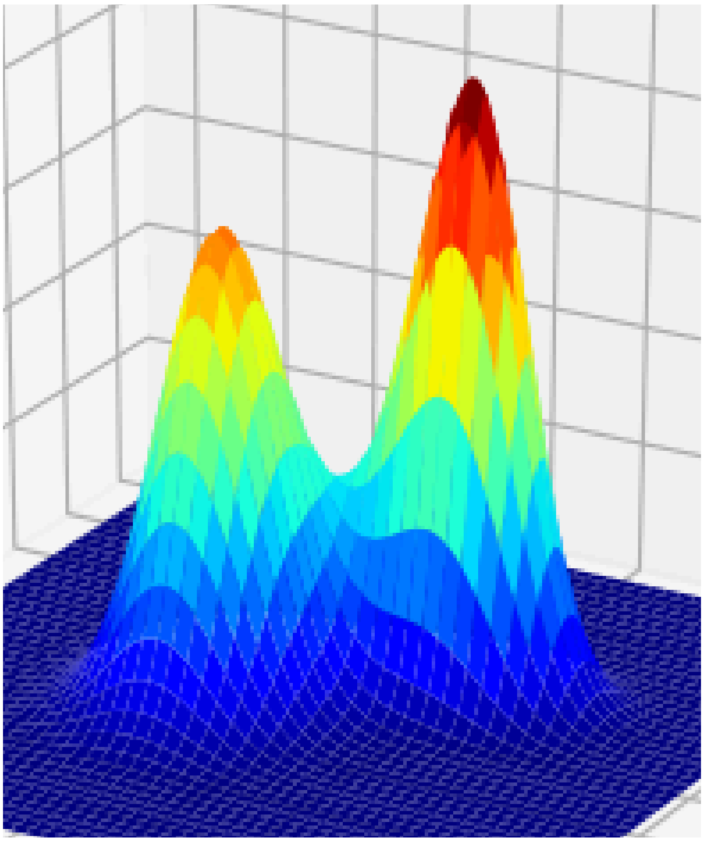
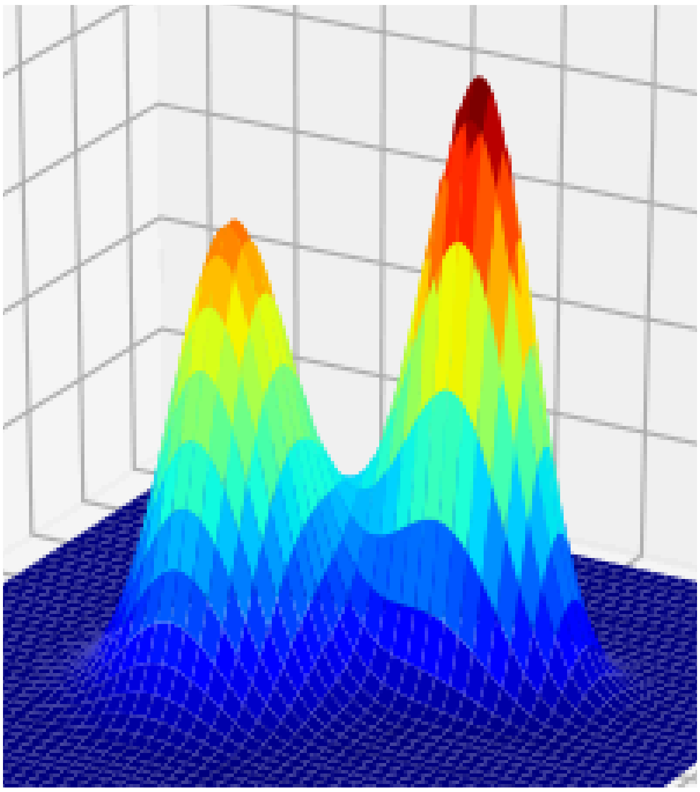
alpha1 = 0.3 alpha2 = 0.22

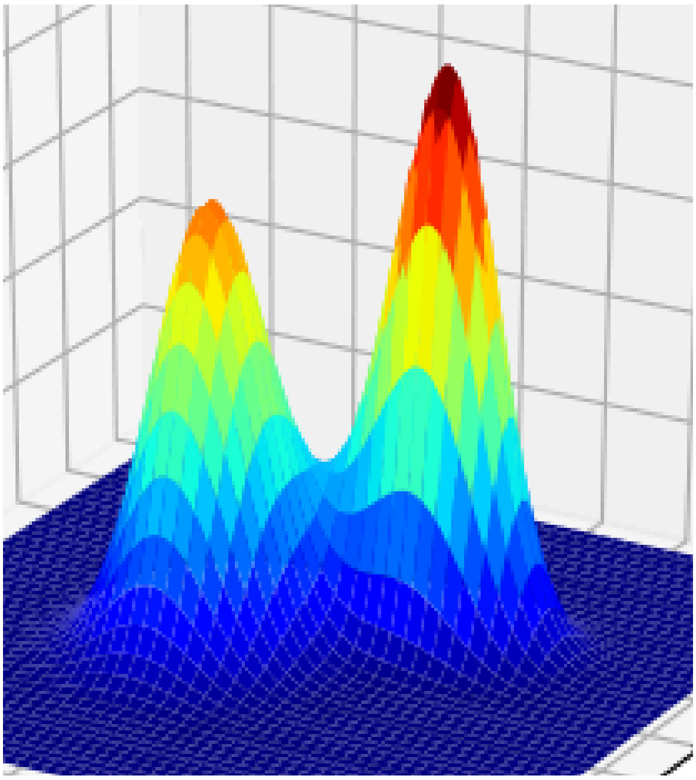
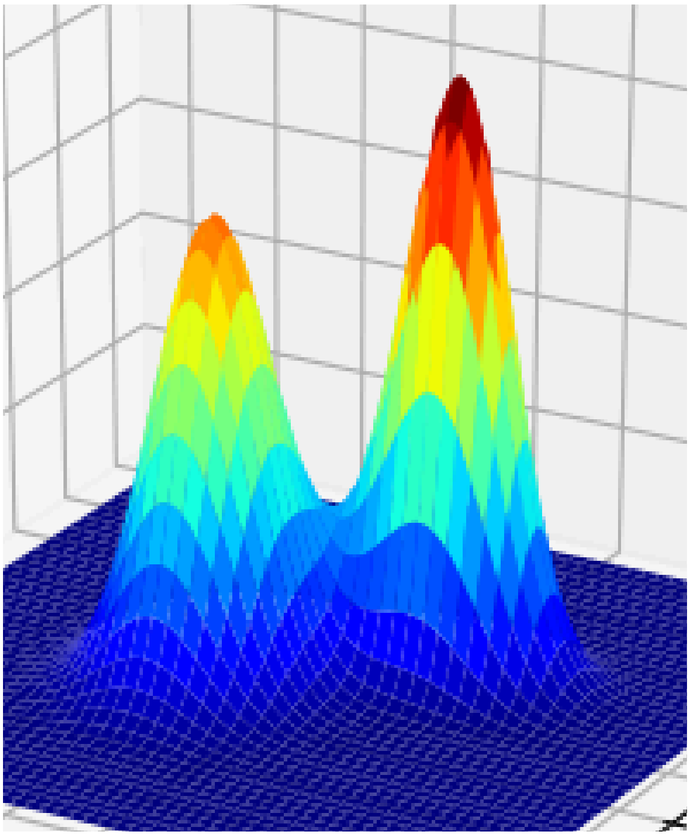


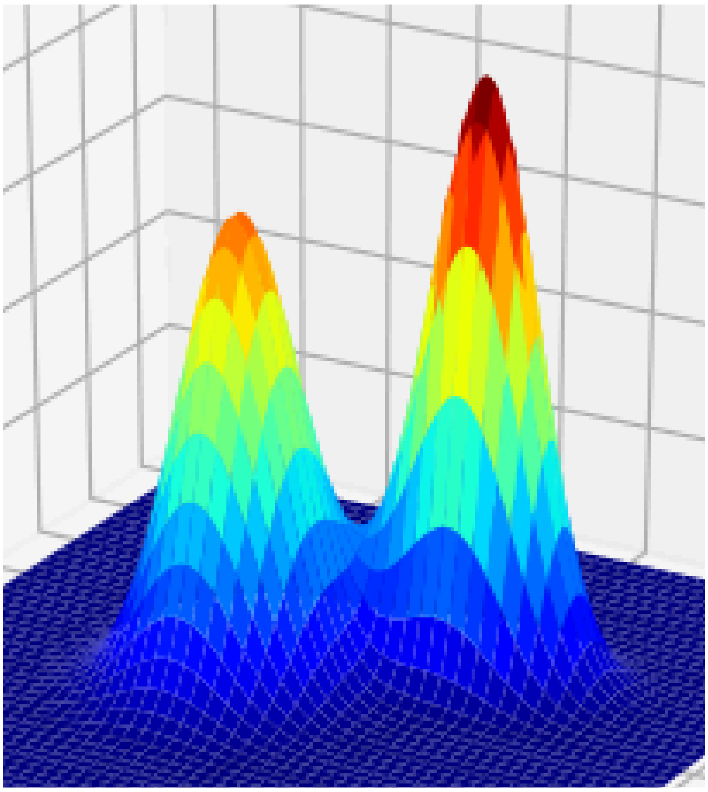
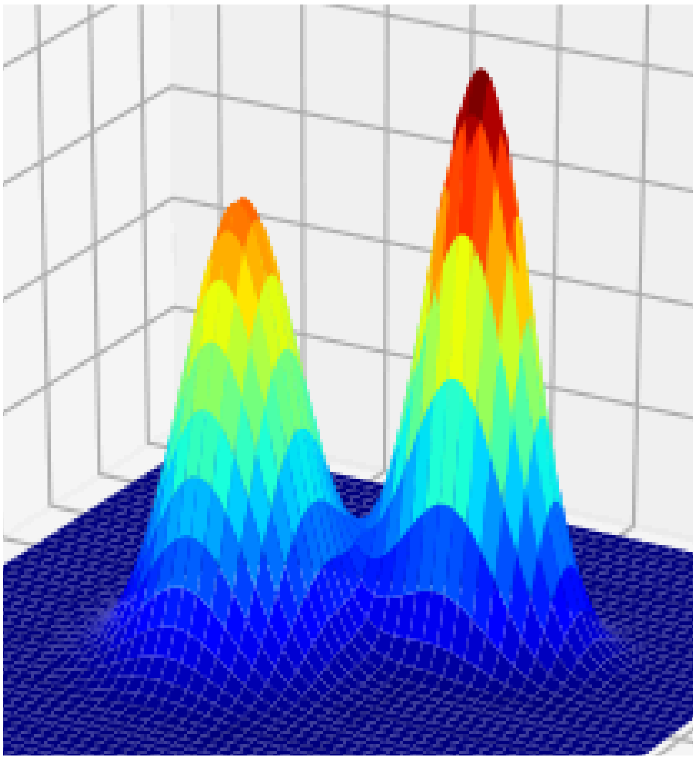
Quantum GMM

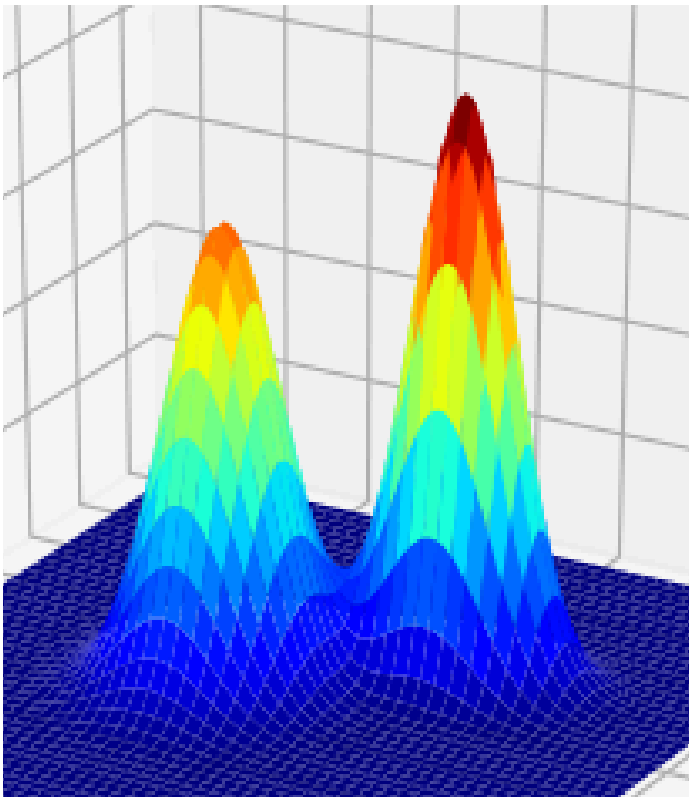
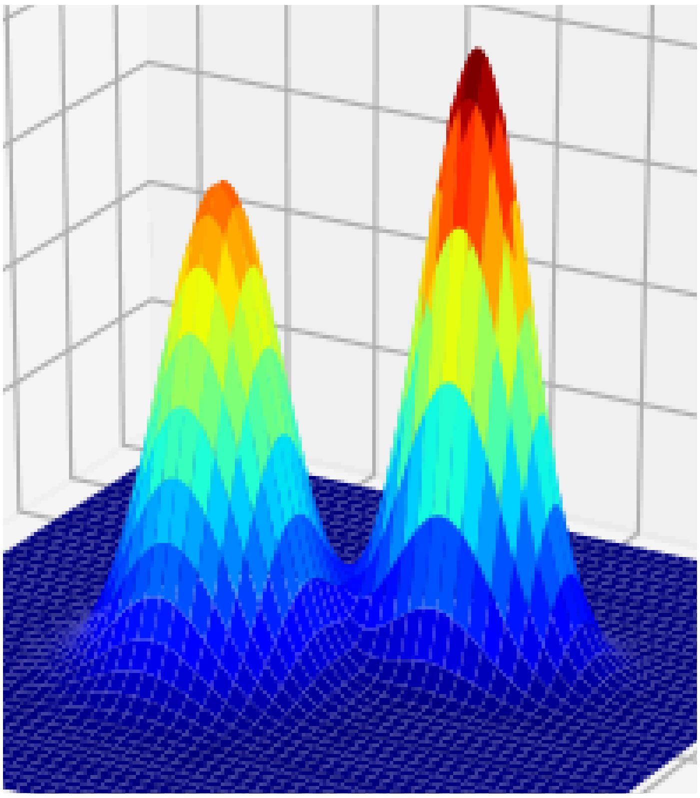
phi	alpha1 = 0.3 alpha2 = 0.22
0	
10	

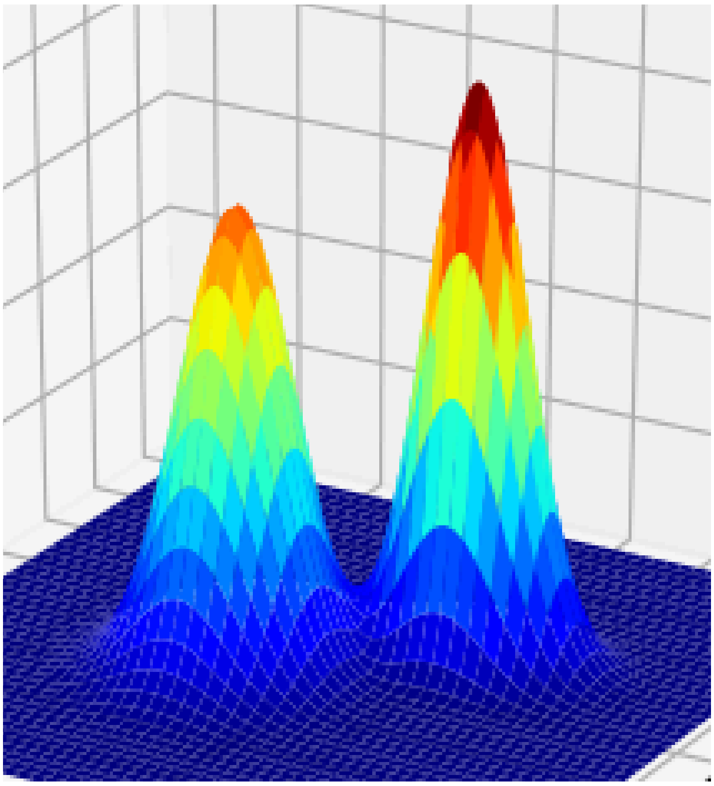
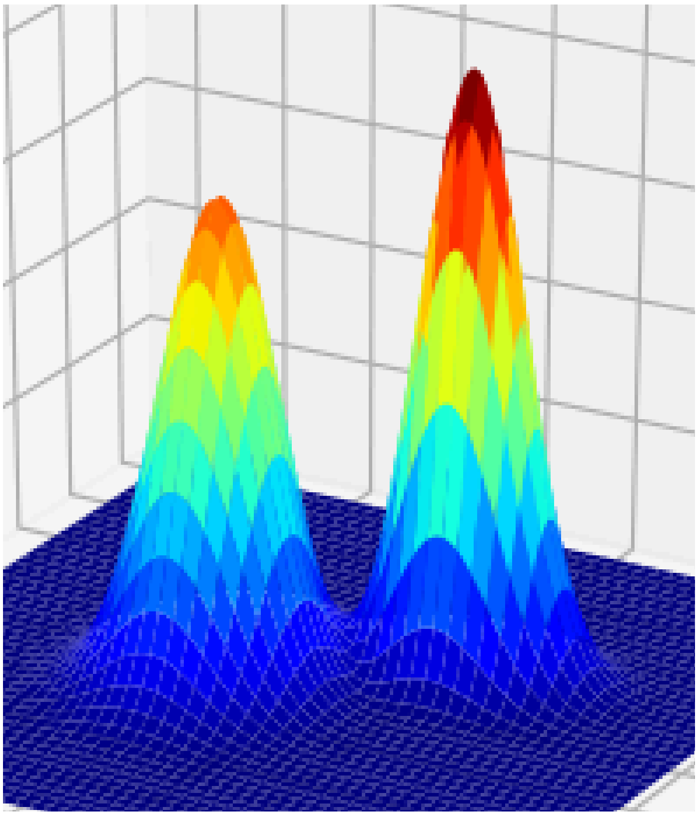
20	
30	

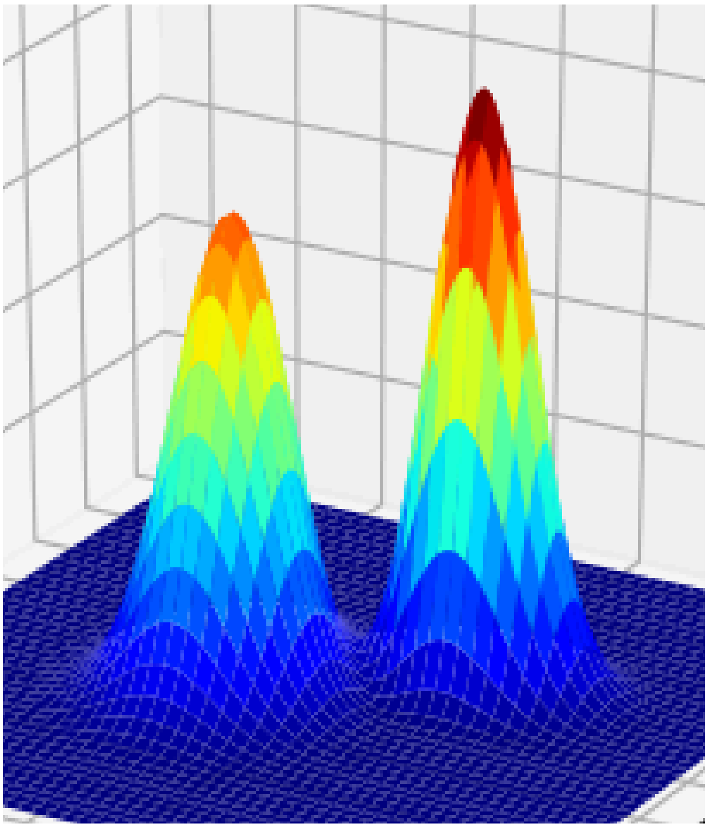
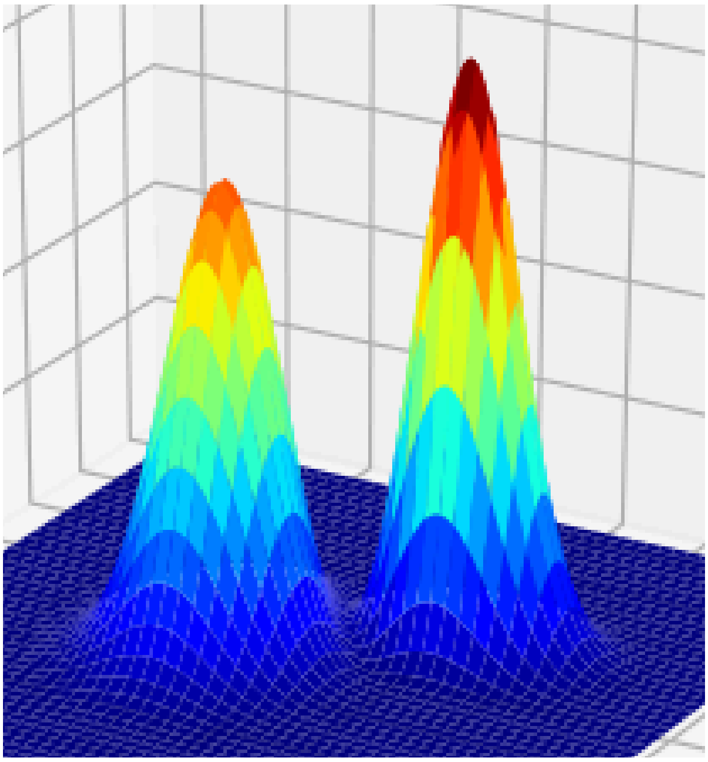
40	
50	

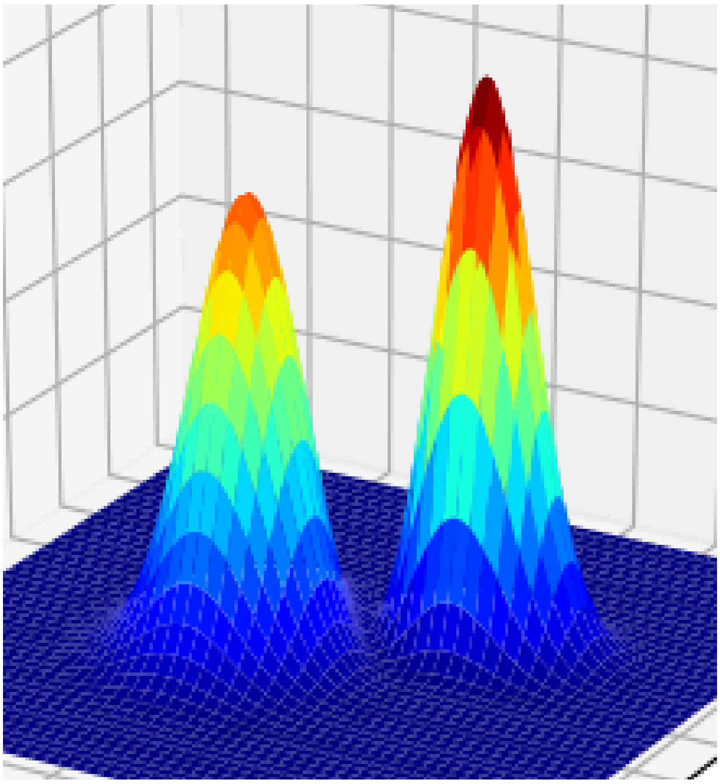
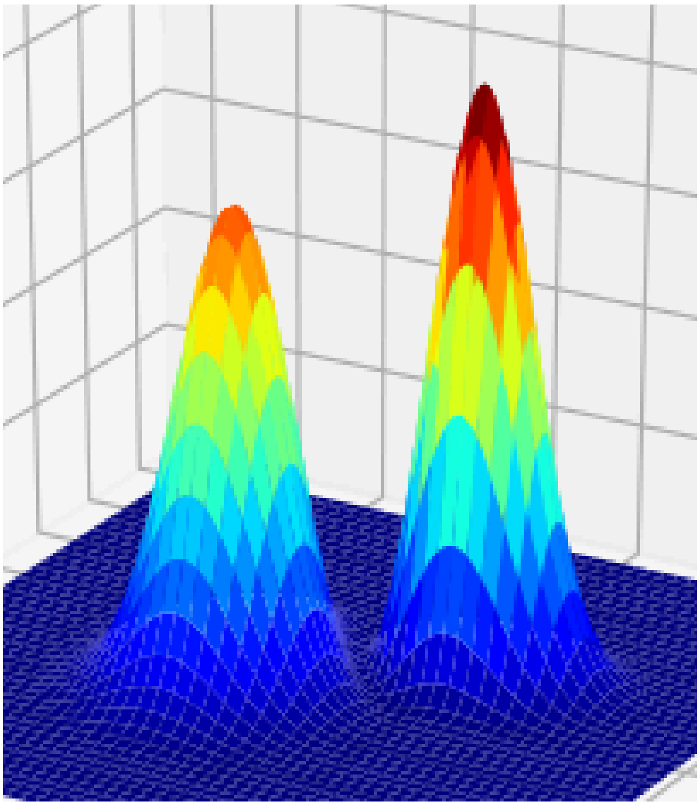
60	
70	

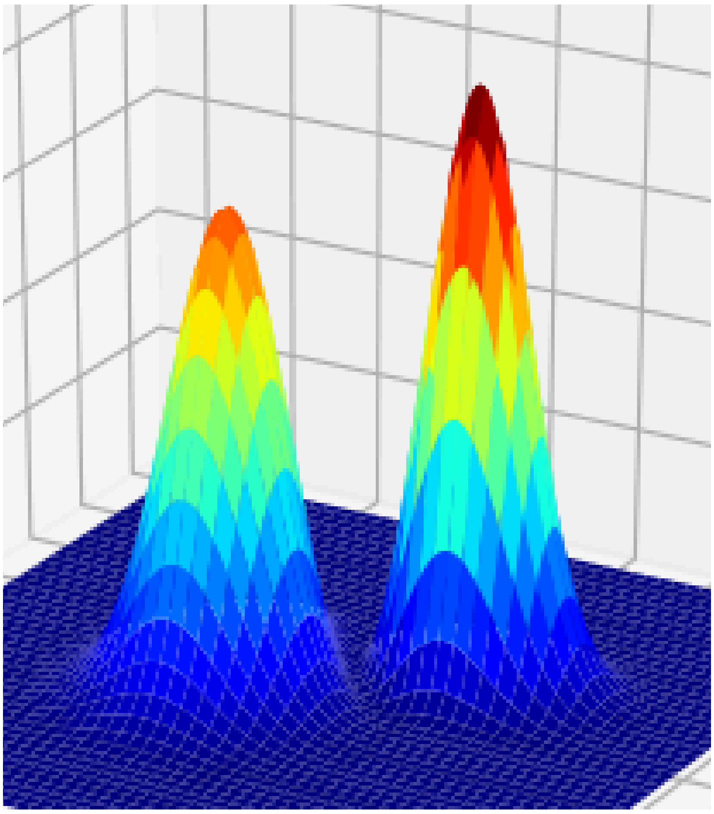
80	
90	

100	
110	

120	
130	

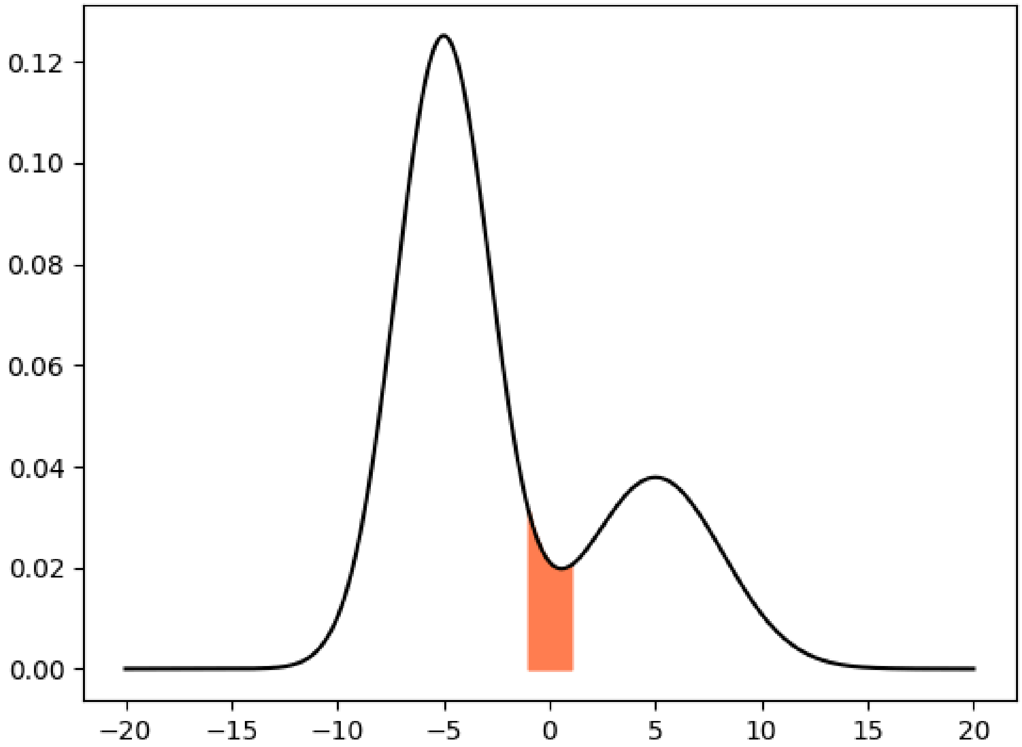
140	
150	

160	
170	

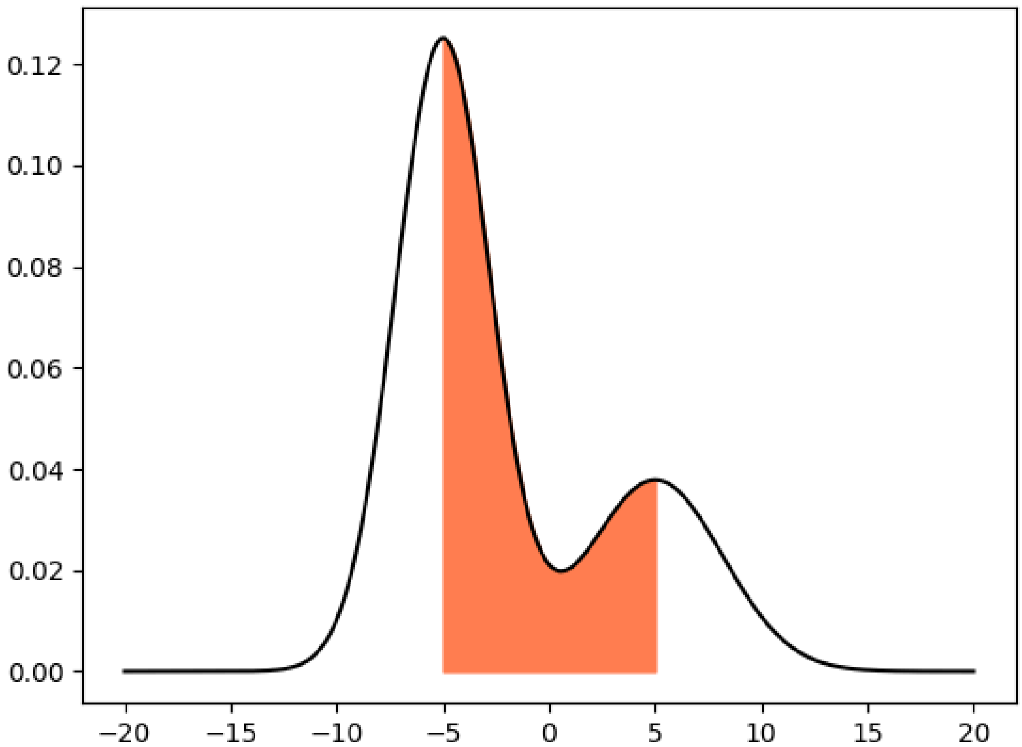
180	

Integral of QGMM probability space

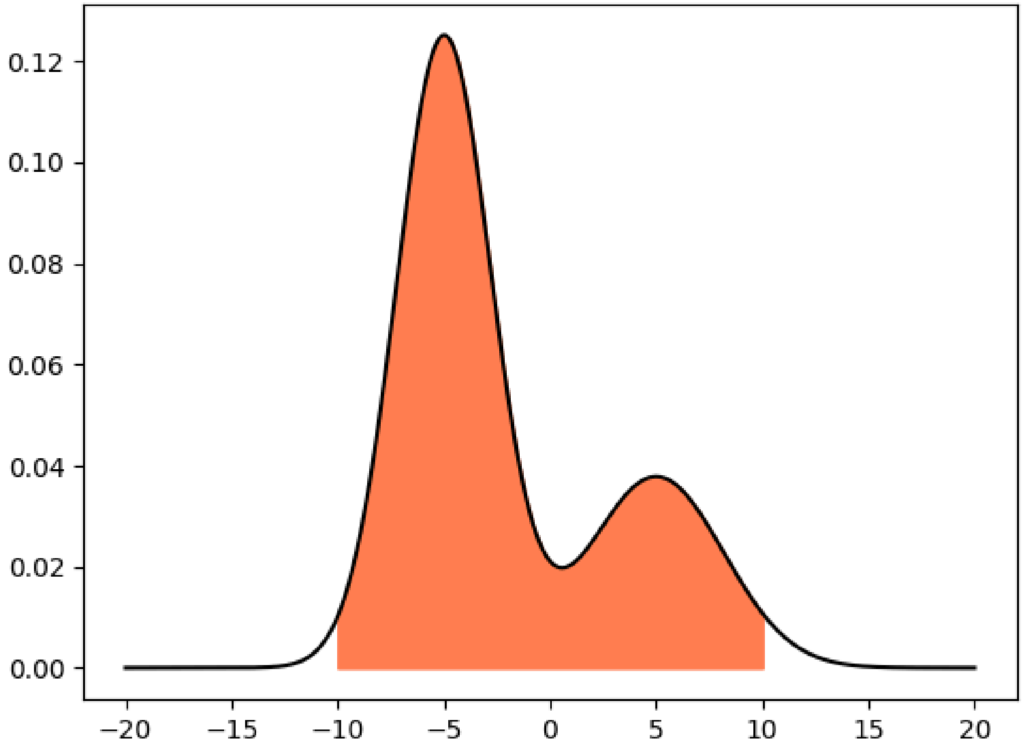
mean = 0, covariance = 1, probability = 0.04544



mean = 0, covariance = 5, probability = 0.4988



mean = 0, covariance = 10, probability = 0.974



mean = 0, covariance = 20, probability = 0.99