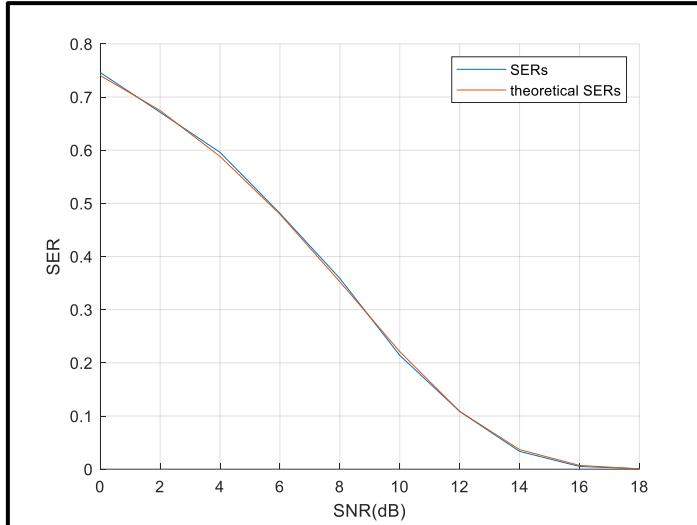


PROBLEM:

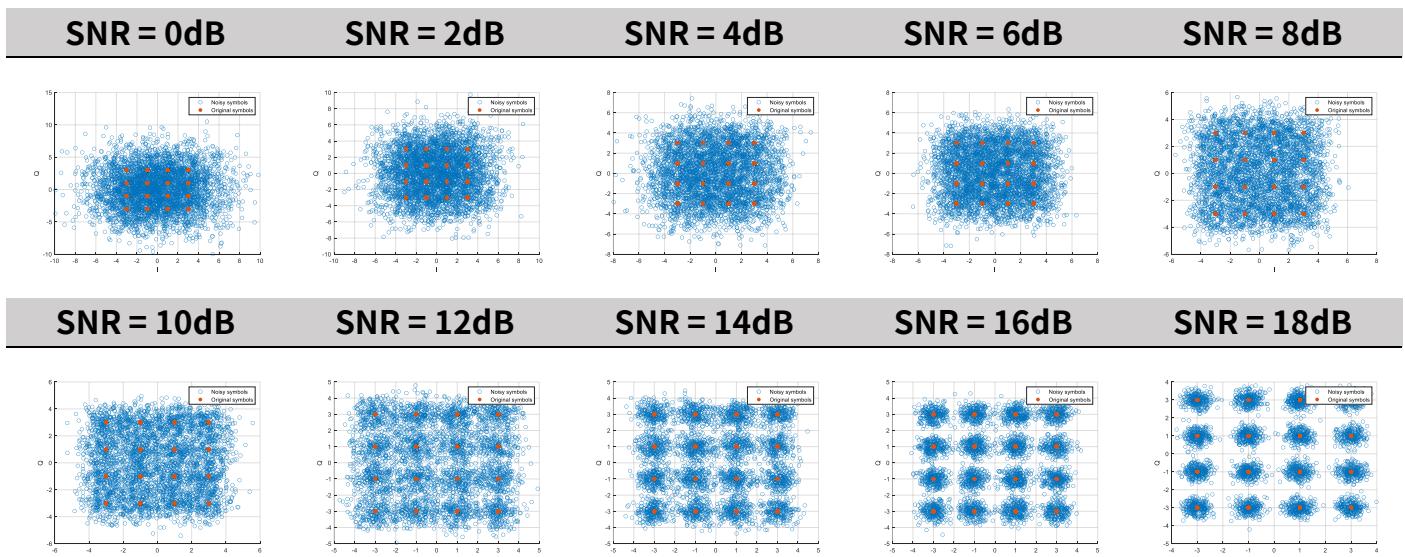
- Simulate the symbol error rates (SERs) of the 16-QAM scheme with SNRs of 0dB, 2dB, 4dB ... 18dB, etc such that you can plot a SER curve.
- Calculate the theoretical SERs and also plot a curve.
- Put these two curves in the same figure to see if your simulation results are OK.



I. S5P3.mat 的 bytestream 加上 noise

SNR 增加，接收訊號會更集中於理想的 16-QAM 星座位置。

使用 minimum distance decision rule 判斷的錯誤率也會降低。



II. theoretical SER 算法

- 16-QAM 視為兩個 4-PAM，分別對應 I 軸與 Q 軸
- 對單一軸的 4-PAM 訊號計算錯誤率 p

$$E0 = 1; p = (6/4)*qfunc(sqrt(E0/(N0/2)));$$

1. 4-PAM 的星座點為 $[-3, -1, 1, 3]$ ，符號間隔為 2，故設定 $E0 = \text{間隔}/2 = 1$

2. 單一軸雜訊能量為 $N0/2$

C. 整個 16-QAM 符號正確的機率為兩軸同時正確的機率

$$\text{theo_SER}(j) = 1 - (1-p)^2;$$