Computational Assignment - 2

EE4140 - Digital Communication Systems

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I certify that this experiment submission is my own work and not obtained from any other source

1) We have a distorting (ISI) channel defining the measurement model as,

$$r(k) = \sum_{l=0}^{L-1} f_l I(k-l) + v(k)$$

In this section, the data symbols $I(k)$ entering the channel $F(z)$ are drawn from a 4-ary PAM alphabet. The channel transfer function is given by

$$F(z) = \frac{1}{\sqrt{2}}(0.8 - z^{-1} + 0.6 z^{-2})$$

For a given noise variance σ_v^2, the SNR measured on $r(k)$ is given by σ_v^{-2}, for a transmit signal power of $E[|I(k)|^2] = 1$.

A Viterbi Algorithm (VA) based sequence estimator has been simulated on MATLAB (assuming perfect information about $F(z)$ is available at the receiver and also the initial state and tail symbols are also known at the receiver). The SER has been experimentally calculated and plotted for various values of SNR and also for various values of trace back length or decoding delay (δ).

We observe that the SER decreases when the decoding delay is increased.

2) We have a distorting (ISI) channel defining the measurement model as,

$$r(k) = \sum_{l=0}^{L-1} f_l \, I(k-l) + v(k)$$

In this section, the data symbols $I(k)$ entering the channel $F(z)$ are drawn from a 2-ary PAM alphabet. The channel transfer function is given by

$$G(z) = \frac{1}{C}\left(1 - 0.95z^{-1} + 0.5z^{-2} + 0.15z^{-3} - 0.2z^{-4} - 0.1z^{-5}\right)$$

(i) We wish to normalize the channel gain to unity by appropriately choosing C.

$$\frac{1^2 + 0.95^2 + 0.5^2 + 0.15^2 + 0.2^2 + 0.1^2}{C^2} = 1$$

$$C = \sqrt{1^2 + 0.95^2 + 0.5^2 + 0.15^2 + 0.2^2 + 0.1^2}$$

$$\Rightarrow C \approx 1.4916$$

(ii) A Viterbi Algorithm (VA) based sequence estimator has been simulated on MATLAB (assuming perfect information about $G(z)$ is available at the receiver and also the initial state and tail symbols are also known at the receiver). The SER has been experimentally calculated and plotted for various values of SNR for a decoding delay of $\delta = 30$.

(iii) Now we simulate a Viterbi Algorithm (VA) based sequence estimator by considering a truncated impulse response (only 4 Trellis states). The corresponding SER is experimentally calculated and plotted for various values of SNR for a decoding delay of 30.

We observe that the SER of the VA based sequence estimator with 32 Trellis states is lower than that of the one with only 4 Trellis states.

3) Required Figures

Figure (1)

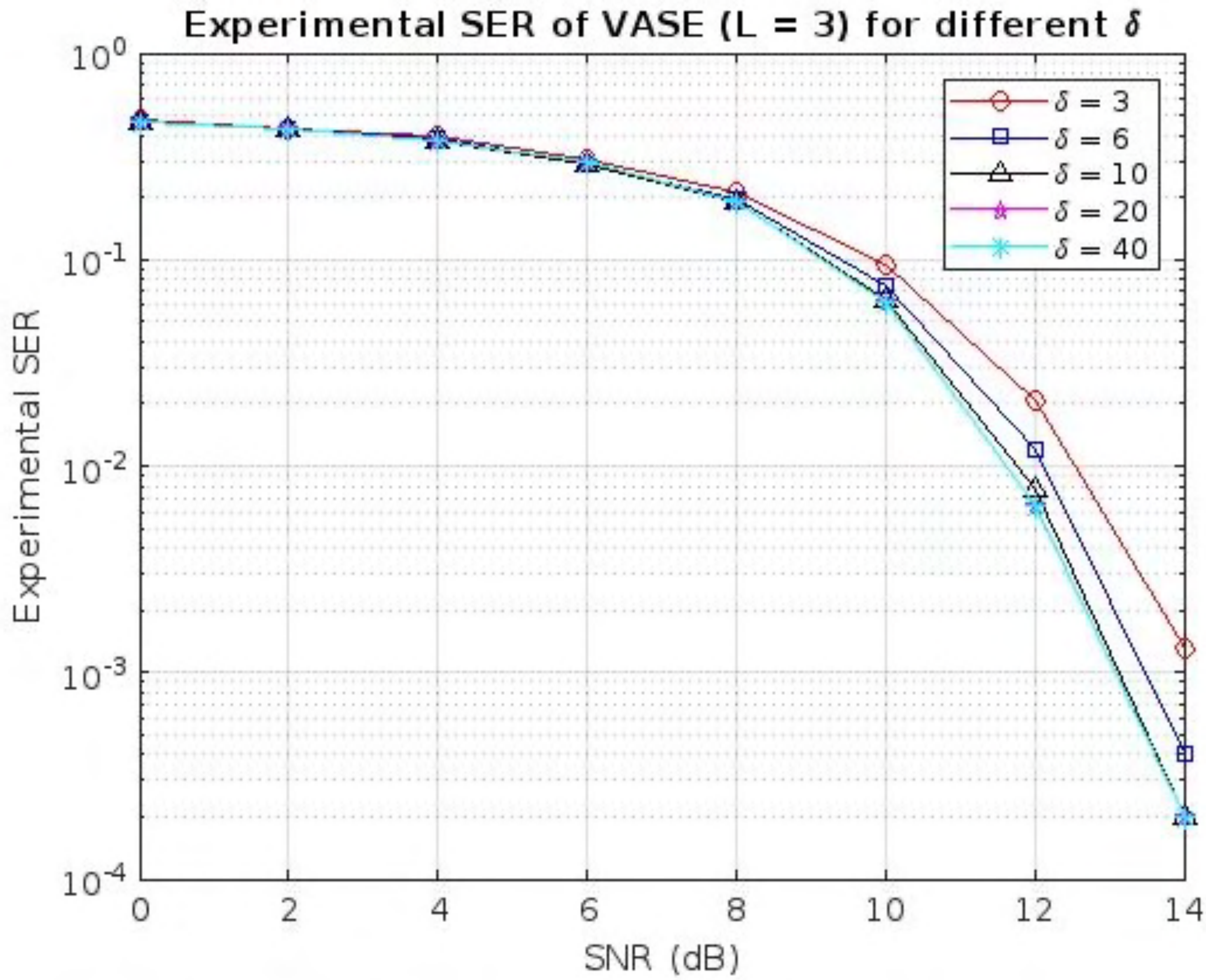
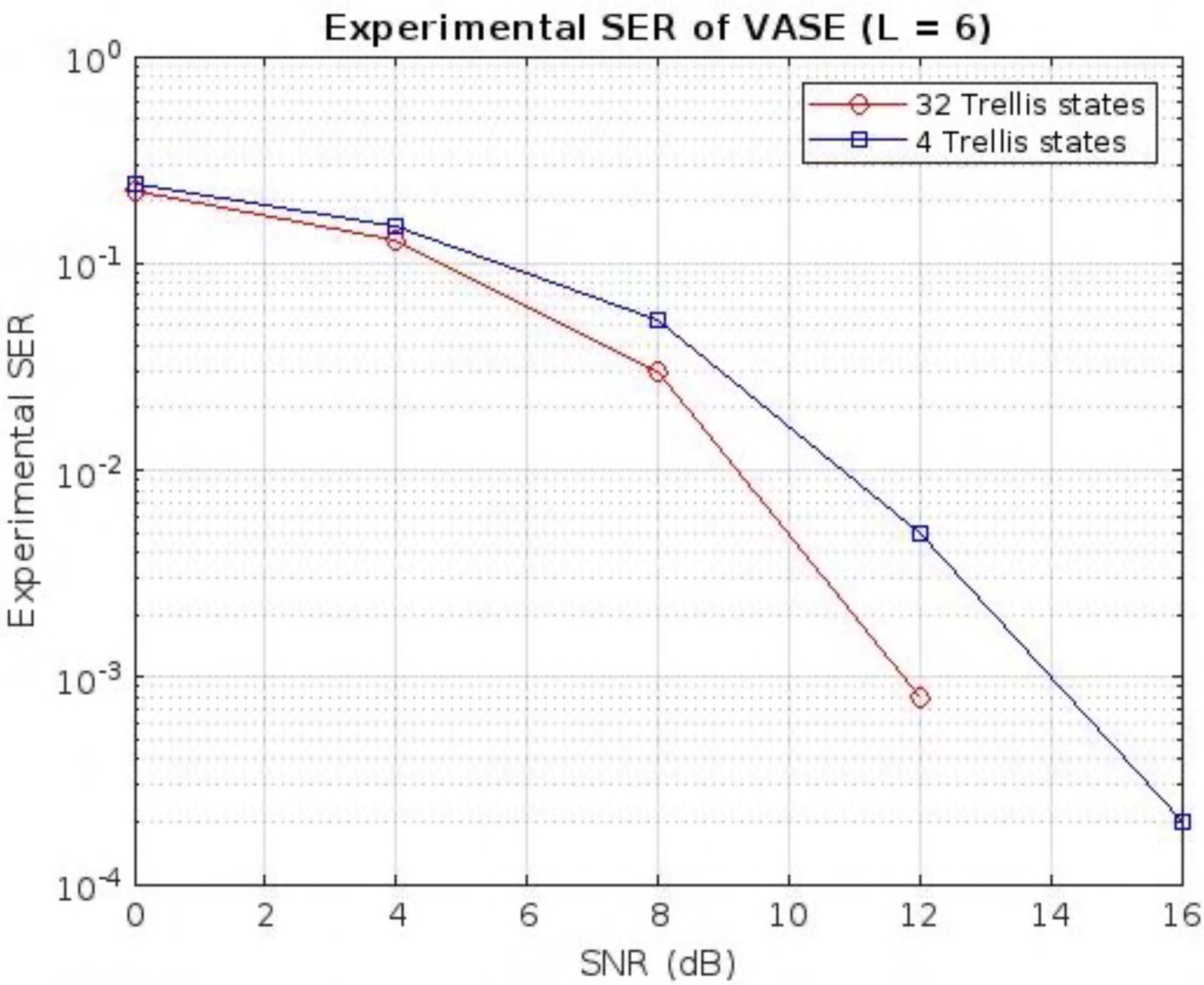


Figure (2)



Experimental SER of VASE (L = 6)
32 Trellis states
4 Trellis states
Experimental SER
SNR (dB)
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
2
4
6
8
10
12
14
16