Communication Systems
Lab – 3 Report

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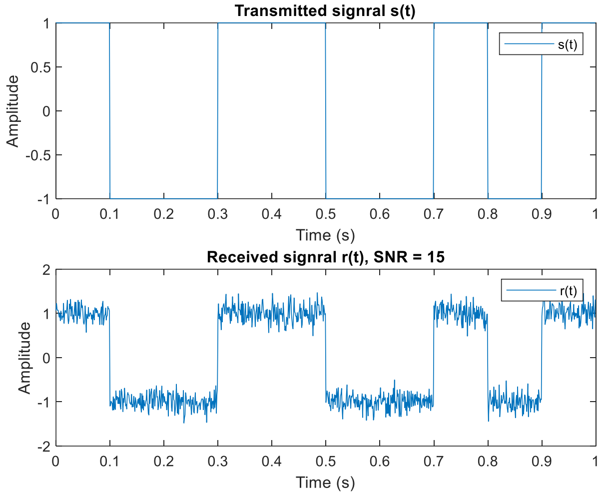
Figure 1 & 4

In these figures, because received signal has white gaussian noise, there are many spikes that may cause error. Since, the SNR is relatively low, when we observe r0(k) and r1(k), we do not see any error. They are consistently ordered on the level of 100 and -100.



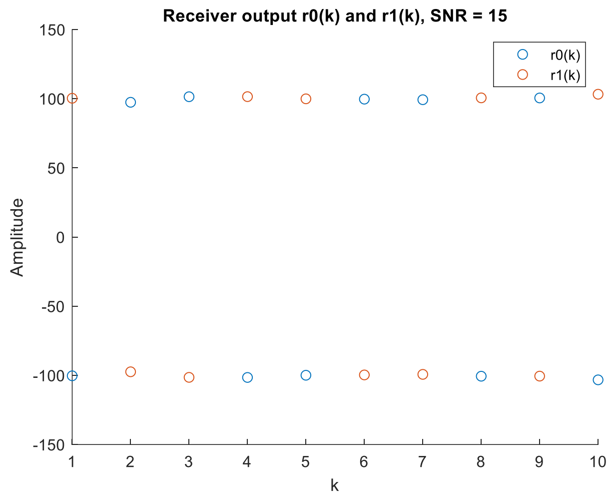
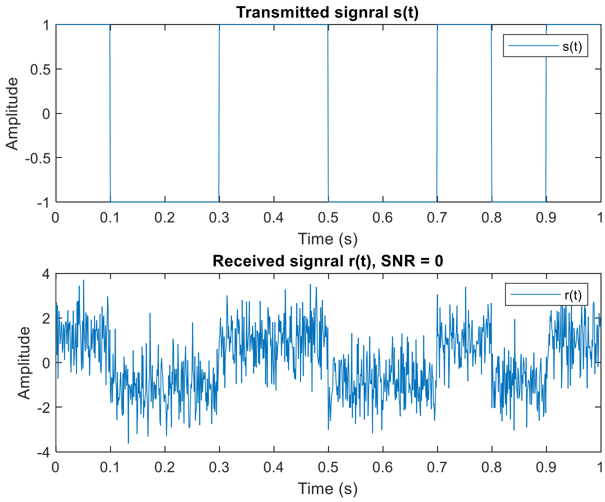


Figure 2 & 5

Just like previous figures, but it has greater SNR rate which results in more severe spikes in the received signal. Therefore, we see that r0(k) and r1(k) are fluctuating around the level of 100 and – 100. However, thanks to the correlation receiver, it eliminates it and gives true results.



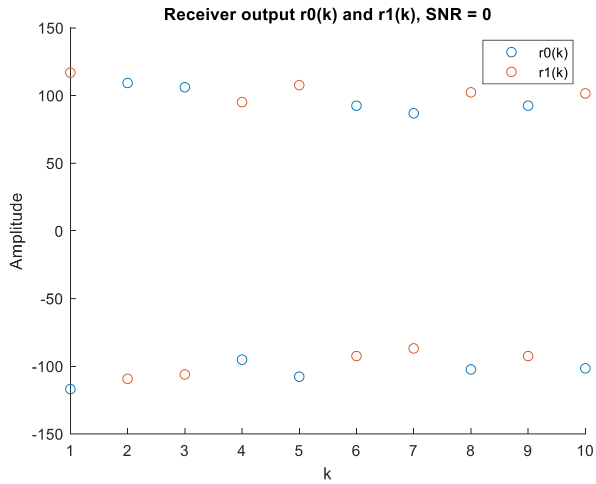
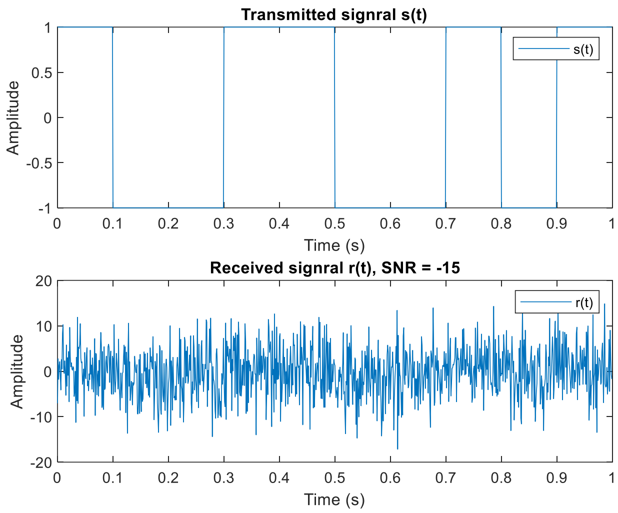


Figure 3 & 6

Since, the additive white gaussian noise is greater, there is great amount of distortion in the received signal. It is so hard for human eye to distinguish the transmitted signal on r(t). For this reason, values of r0(k) and r1(k) are far from the level of 100 and -100 which may cause an error and they also goes others places. For example, at k = 3 r0 and r1 values interchanged which will arise as an error.



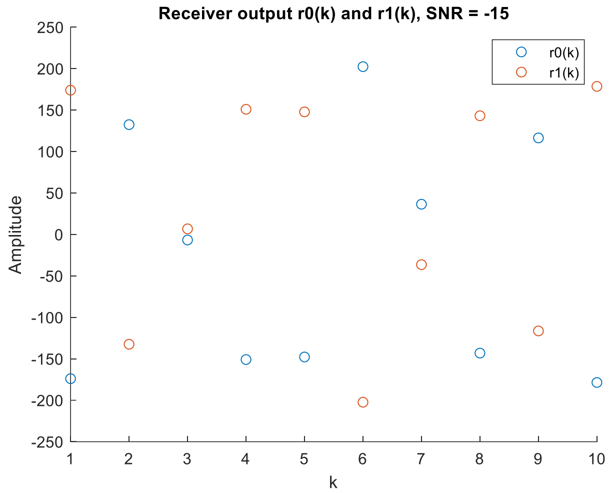
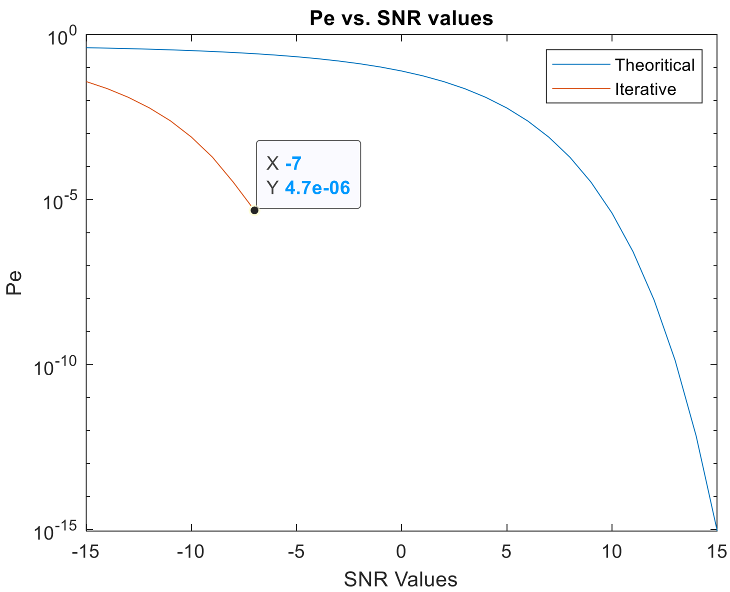


Figure 7



As we expected, when we increase the value of SNR, we theoretically see less error. Also, when we decrease it, the probability error increases because correlation receiver cannot distinguish the right signal when the noise influences the signal severely. For iterative signal, it is less than theoretical one and it is zero after -7 SNR because after some value the computer does not come across with any error. (I changed my Q function from Q(SNR) to Q(sqrt(2*10.^(SNR/10))) and I changed my iterative probability error code).

Comments

3.3 – c.

When we increase SNR value, we see better r(t) results because SNR represents the ratio of signal power to noise power. If we have less noise, correlation is able to recreate the original signal easily with no error. On the other hand, with high noise (less SNR), we will start to see erroneous output signals.

3.4

By comparison, I do not see any error after -7 SNR. However, in theory, there should be some error. This happens because our precision of the iterative error is limited by our iteration number. For example, if our maximum iterated bit sample number is 1000, the lowest error probability is 10^-3 except 0. Therefore, we see 0 for the most of the values because they are less than 10^-3. In my simulation, my sampling number is 10^7. Furthermore, the result of Q function gives us directly error of gaussian distribution. However, our iterative result is giving error of correlation receiver, so correlation process eliminates some portion of errors. That is why, iterative result is lower and better than theoretical result in the figure.

3.5 – b.

In those figures, SNR value just affects the proportion of the additive white gaussian noise at the received signal. It is seen on the figures that lesser SNR generates less noised and more original like signals. However, at higher SNR values, such as 15, the signal is very distorted by additive white gaussian noise.

3.5 – c.

We see that, ideally when the symbol is s0, r0 is 100, r1 is -100 and when it is s1, r1 is 100, r0 is -100. At higher SNR values, receiver works close to ideal values. However, when we decrease SNR, we see values far from 100 and -100 which results in error. When the symbol is s1 and r0 is greater than r1, the detector will generate s0 symbol which is wrong, also the opposite is valid. Therefore, within less SNR values, r0 and r1 values tend to interchange their positions and this causes misdetections.

3.5 – d.

We see decreasing behavior in the figure because as expected, lower SNR values result in high noise ratio which causes error at the output of the receiver. We see this behavior as probability when we calculate it with the formula and with the simulation. At higher SNR values, probability of error rapidly decreases because when the signal is like the original one detector of correlation receiver does not have any difficulty to distinguish symbols. On the other hand, when the signal has high noise, in lower SNR values, the detector has higher change to generate error, so we see higher error probability at lower SNR values.