EECE 340 Project Module 4 Report

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4- Modulation:

1. BPSK Modulation:

The code performs BPSK modulation. The function takes two arguments: a binary sequence "b" and an amplitude "A". The function initializes a zero vector "x" of the same length as the input binary sequence "b". It then loops over each bit in the sequence and checks if it is equal to 1 or 0. If it is 1, the corresponding value in the output vector "x" is set to the amplitude "A". If it is 0, the corresponding value in "x" is set to the negative amplitude "-A". Finally the function returns the resulting modulated signal "x".

1. BPSK Demodulation:

The code performs BPSK demodulation. The function takes in a BPSK modulated signal "x" and returns the binary data "b" that was modulated. ". The function initializes a zero vector "b" of the same length as the input binary sequence "x". It then loops over each element in the input signal "x". If the element is positive or zero, it is assumed to correspond to a transmitted 1 bit and is assigned a binary value of 1. If it is negative, it is assumed to correspond to a transmitted 0 bit and is assigned a binary value of 0. Finally the resulting binary data is then stored in the "b" array and returned.

1. QPSK Modulation:

The code performs QPSK modulation. The function takes in two arguments: a binary input sequence “b” and an amplitude “A”. The binary sequence 'b' is converted to decimal values and each decimal value is assigned to its complex number using the given information. The assigned complex numbers are then multiplied by “A/sqrt(2)”. Finally, the function returns the modulated signal “x”.

1. QPSK Demodulation:

The code performs QPSK demodulation. The function takes in a QPSK signal in complex form and assigns the complex symbols back to binary digits. The function creates an empty array "b" to store the binary digits of the demodulated signal. It then iterates through the length of the received signal "x", and for each complex number, it checks the sign of the real and imaginary parts and assigns it back to the corresponding binary digit. Finally, the function returns the demodulated signal “b”.

1. Modulation Test:

This code tests the performance of BPSK and QPSK modulation and demodulation in the absence and presence of additive white Gaussian noise (AWGN). First, it generates a random bit stream for BPSK and QPSK modulation and demodulation, and modulates them using BPSK\_mod and QPSK\_mod functions respectively. Then, it demodulates the modulated signals using BPSK\_demod and QPSK\_demod functions, and checks if the recovered bit stream is equal to the original one. The isequal of the bpsk and the qpsk should both

return “1”. After that, the code adds AWGN to the modulated signal of QPSK then BPSK for different signal-to-noise ratio (SNR) values. It calculates the bit error rate (BER) for both QPSK and BPSK modulation schemes, and stores them in biterrorrate\_vector\_bpsk and biterrorrate\_vector\_qpsk respectively. Finally, we plots the BER versus SNR for both modulation schemes using the semi-log function since values are in dB.

As mentioned above the isequal both returned true, and we verified that the functions work on regular streams of bits. However, after adding complex errors, the bit error rate (BER) is shown for the QPSK in figure 1 and BPSK in figure 2. We can see that the BPSK bit error rate(BER) is approximately 0.5 which does not decrease with respect to SNR since it is not designed to handle complex number. The QPSK bit error rate starts out at approximately 0.1 at 0 SNR which decreases to approximately 0 at 10 SNR. This is due greater signal power compared to the noise power. This results in fewer errors in the received signal, which leads to a lower BER. In other words, a higher SNR means that the transmitted signal is more reliable and less susceptible to errors caused by noise.

