1 Digital Communication - Modulation and Demodulation

In this labsheet you will study digital communication over ideal passband channels under the assumption of perfect frame and symbol (or bit) synchronization. For completing the tasks in this lab, you can use the Matlab files provided. The Matlab files are not solutions to the tasks in this labsheet. So you should use the Matlab files as a guide to complete the tasks.

Passband communication

1. Generate a sequence of 10 bits.
2. Generate the baseband signal for the above sequence of bits corresponding to both BASK and BPSK.
3. The rest of the tasks have to be done for both BASK and BPSK if not explicitly mentioned.
4. Plot the power spectrum of the baseband signal.
5. Modulate the baseband signal using a carrier of frequency 50Hz.
6. Plot the power spectrum of the modulated signal.
7. Simulate sending the modulated signal through an ideal passband channel with zero propagation delay.
8. At the output of a channel implement a passband receive filter with a passband corresponding to the bandwidth of the signal that you are sending through the channel.
9. Implement a coherent demodulator for both BASK and BPSK. Plot the spectrum of the output of the coherent demodulator for both cases.
10. At the output of the demodulator, implement a matched filter for the pulse shape that you have used.
11. Obtain samples from the output of the matched filter; note that since an ideal channel is used, these samples can be taken at multiples of the bit times.
12. Implement a decision making device - a thresholder that will convert the samples to 0 or 1 based on whether your baseband signal is for BASK or BPSK.
13. (Optional): Implement a non-coherent demodulator for BASK.

Error performance for passband communication

1. Modify the channel to introduce sampled additive white Gaussian noise with variance σ^2.
2. For the digital communication setup that you have above, obtain the bit error rate which is the fraction of bits in error. Do this first for a variance of 1. The bit error rate should be obtained for the simulation of the transmission of a large number of bits, say 1000. Please note that you have to compare the bits that are received with the bits that are sent in order to compute this bit error rate.

3. Plot the bit error rate as a function of the noise-variance. For making this plot, you have to consider different values of the noise variance. For each value of the noise variance, generate the bit error rate value for 1000 bits, 10 times. Take the average of the 10 bit error rates as the bit error rate for that noise variance. Repeat for all values of the noise variance.