AV343 – Miniproject 2,
Department of Avionics,
Indian Institute of Space Science and Technology.

(Optional miniproject – not required to submit)

In this mini-project you will setup a Matlab simulation of a complete BPSK system. You will setup up the different parts of the BPSK system in parts, guided by the Matlab code provided to you. You can use a sampling frequency of 1 kHz in the following tasks. Assume that the bit time used is Tb = 0.1 secs.

Task 1: Generation of a sequence of frames

1. A frame consists of 50 data bits which have to be generated as independent samples from a Bernoulli distribution with p = 0.5. The frame format consists of 10 bits 0101010101 followed by a 13 bit Barker sequence 1111100110101 followed by the 50 data bits.
2. In every frame, 0s and 1s are converted to -1s and 1s respectively and then converted to channel input waveform using square root raised cosine pulse shapes.
3. Generate 10 such frames. The frames are transmitted not contiguously but with gaps of duration G in between two frames. The gaps G are generated from independent samples from a uniform distribution in [0, 50] x Tb. Note that during the gaps there is no transmission.

Task 2:

1. Assume that the BPSK signal needs to be transmitted over a passband channel centered at 120 Hz with a one-sided bandwidth of 20 Hz. Obtain a passband channel model meeting these specifications.
2. Convert the baseband signal that you have obtained in Task 1 for the 10 frames with gaps in between to a passband signal which can be sent through the above passband channel. Simulate the transmission of the signal through the channel. After passing through the channel, simulate the addition of noise by adding Gaussian samples with mean 0 and variance of 2.

Task 3:

1. Demodulate the received signal using coherent demodulation. The coherent demodulation requires you to first have a receive bandpass filter matched to the channel, followed by a method to generate a carrier matched to the received carrier signal. The generated carrier signal should be used to multiply the received and bandpass-filtered signal.
2. Do matched filtering on the baseband signal obtained from demodulation.

Task 4:

1. Implement early-late sampling to sample the received signal at the times at which the average eye-opening height is maximum.
2. Apply a thresholder on the output from the early-late samples to obtain the bit estimates.

Task 5:

1. Using the autocorrelation based frame recovery technique, obtain the frames back from the bit sequence.

Task 6:

1. Think about how this can be extended to a simulation of QPSK.