

1 Simulation of a Baseband Communication System

In this labsheet you will simulate a baseband digital communication system over baseband channels under the assumption of perfect frame and symbol (or bit) synchronization. Please try to modularize your code as much as possible by separating out different tasks into functions which can be reused. All plots should have clearly labelled axes.

Setting up a simulation of the baseband digital communication system

1. Generation of bits: The source is assumed to produce a stream of bits. The bits are usually modelled as an independent and identically distributed random process with the probability of a bit being 1 being 0.5. Generate a random sequence of bits of length N (input) satisfying this property.
2. The above bit sequence is then converted to a baseband signal. The baseband signal is obtained by converting 0 and 1 into appropriate pulses of duration $T = 0.1$ s. For a bit sequence with $N = 10$, obtain a baseband signal with 0 represented using a level of -1 and 1 using a level of 1. Note that all continuous time signals have to be represented by their sampled counterparts. Clearly state the sampling rate that you have used. Plot the sampled version of the continuous time signal that you have obtained.
3. Plot the power spectrum of the baseband signal for $N = 1000$. Note that the power spectrum should be plotted with respect to the continuous time frequency (Hint: carefully think about energy vs. power). Along with this plot that you have obtained, plot (i.e. use *hold on* in Matlab) the PSD that we have obtained from theory in class - compare and contrast the measured spectrum and spectrum obtained from theory.
4. For modelling a baseband channel use any FIR filter design technique to obtain a filter response that corresponds to a channel with passband edge at 20Hz and a gain of g in the passband. Plot the magnitude spectrum of the channel that you are using - clearly labelling the axes for $g = 1$.
5. Simulate sending the baseband signal through the above channel. Plot the output signal from the channel.
6. At the output of the channel, implement a low pass receive filter. Plot the magnitude response of the filter that you have implemented. What are the specifications of the passband and stopband for this filter? Why did you choose those specifications?
7. Obtain samples from the output of the filter; in this set of tasks the sampling times can be manually set by inspection of the channel output signal.
8. Implement a decision making device - a thresholder that will convert the samples to 0 or 1, and obtain the bit estimates at the output of the decision device.