8 Preliminaries

In this laboratory, we cover the noise in frequency modulation (FM). For FM, the frequency of the carrier signal changes depending on the amplitude of the message signal. In addition to these works, in this week, we include the noise to our consideration. The term noise is used to represent unwanted waves that disturb the transmission. While simulating our analog systems, we can generate noise by using some built-in functions in Matlab. For this laboratory, it is useful to learn about the Matlab functions *load(.)*, *fmdemod(.)*, *awgn(.)* and *sound(.)*.

9 Labwork (FM in noise)

9.1 Construction

a) Load the sound file **"gong"** that is given in the Matlab library by using *load()* function.

b) Take the signal and sampling frequency F_s from 1x1 struct as the message signal $m(t)$ and sampling frequency respectively f_s. **Hint**:x=load('gong'), mt=x.y, mt=mt', fs=x.Fs

c) Obtain time vector t = 0:(1/fs):(numel(mt) - 1)/fs where mt is the message signal.

d) Construct the carrier signal where $c(t) = cos(2\pi f_c t)$, with $f_c = 2kHz$.

9.2 Modulation

a) Obtain FM signal X_{fm} with $k_f = 10000$. *Hint*: There is no restriction on taking integral. Do not use *fmmod(.)*

b) Add additive white Gaussian noise (AWGN) with signal to noise ratio (SNR) values of 0dB, 5dB,10dB and 20dB using *awgn()* to your modulated X_{fm}.

9.3 Demodulation and Filtering

a) Demodulate your FM signals using *fmdemod()* function and using a low pass filter (LPF) with suitable filter order.

b) After filtering, you will obtain the demodulated message vectors.

c) Listen to the demodulated message vectors with different SNR values by using *sound()* function.

d) Comment on the sound quality.

9.4 Mean Square Error (MSE) and comparison

a) Use the MSE function from previous lab to calculate the MSE values of the filtered signals with 4 different SNR values and message signal.

b) Plot the calculated MSE values with respect to SNR.

c) Comment on the result.