University of Rhode Island Department of Electrical and Computer Engineering
ELE 435: Communication Systems

FM MATLAB assignment

1. Matlab Code

    (a) Modulation: Generation of an FM signal:

    i. Generate an FM signal, given by $s(nT_s) = A_cCos((2\pi f_1nT_s) + \beta sin(2\pi f_2nT_s))$, where $A_c = 2$, $f_1 = 20KHz$, $f_2 = 200Hz$, $T_s = \frac{1}{f_s}$, $f_s = 80KHz$, and vary β for example 0.2, 1, 5 etc.

    ii. Note: This is the same signal you used for the mini-project.

    (b) Demodulation: Build an FM receiver (demodulator) using Hilbert Transform

    i. Take the Hilbert transform of the above generated FM signal, the result is $c(nT_s) = e^{j((2\pi f_1nT_s)+\beta sin(2\pi f_2nT_s))}$. Use the hilbert command in matlab.

    ii. Take the conjugate of the Hilbert transform.

    iii. Plot the angle of result generated by $c(nT_s)c^*((n-1)T_s)$, where $c^*((n-1)T_s)$ is the conjugate of hilbert and is also shifted by one sample.

    (c) Design a Low Pass Filter and Band Pass Filter for different Filter orders. Show plots for Orders 10 and 100. Use freqz command in MATLAB to see the characteristics. You may want to run for few more filter order values and cut-off frequency values gives below to see the filter characteristics.

    (d) MATLAB Help:

    i. To design a Low Pass filter: b = fir1(filterorder,$f_c/(f_s/2)$), where $f_c/(f_s/2)$ is called the normalized cut-off frequency

    ii. To design a Band Pass filter: b = fir1(filterorder,[$f_{b1}/(f_s/2)$ $f_{b2}/(f_s/2)$])

    iii. To check the characteristics: Try freqz(b,1,512)

    iv. Parameters: $f_c = 10$ KHz, $f_{b1} = 6$KHz, $f_{b2} = 12$K, $f_s = 40$ KHz,

    (e) JUSTIFY/Comment on the matlab commands you used in the code to obtain credit.