In this homework, you are given a .wav file which has a signal which contains three audio recordings, each of two seconds duration.

* signal 1 is unmodulated,
* signal 2 is modulated with 2 KHz, (ie, multiplied with sin(2*pi*2000*t)
* signal 3 is modulated with 4 KHZ. (ie, multiplied with sin(2*pi*4000*t)

Each audio signal is recorded at 176400 samples per second. Then two of them are modulated, and all three added together.

You are asked to filter out and demodulate each of the three audio recordings and find out what they say.

STEPS TO FOLLOW

1. Load the attached .wav signal to matlab and take its fourier transform (use fft() function). Plot the magnitude (use abs() function) of the result. You should be able to see each of the three voice recordings individually, well-separated from the others.
Print the result in your homework.. (one plot)
2. Form three separate voice signals:

– filter out signals 2 and 3, and leave only signal 1.
– filter out signals 1 and 3, and leave only signal 2.
– filter out signals 1 and 2, and leave only signal 3. You have to do this filtering operation in frequency domain.

Print the result in your homework. (three plots)

3. Signal 1 can be directly played. You can return it back to time domain by taking its inverse fourier transform (Use MATLAB's ifft() function), and then send it to the speaker. But your computer's audio card may not be able to play 176400 samples per second. In that case, you may reduce the number of samples to your computer's standard (typically 44100 samples per second) by using MATLAB's interp() function.
Attach the wav file containing signal 1 to your homework..
4. Signals 2 and 3 must be demodulated before being played. For this

—4a. return each signal to time (ifft)
—4b. multiply it with a sine whose frequency is the modulation frequency
—4c. return back to frequency (fft)
—4d. filter out the side lobes that are the result of the previous step (4b), and leave only the central lobe..
—4e. return back to time (ifft) and send the signal to speaker. Use interp() if necessary

Print the result of step 4c for both signal 2 and signal 3 your homework (two plots). Attach two the wav file containing signals 2 and 3 to your homework.

DELIVERABLES

1. One plot from step 1 (input signal in frequency domain)
2. three plots from step 2 (three filtered signals in frequency domain)
3. Two plots for step 4c. (result of multiplication by a sin()). Plots must be in frequency domain.
4. three .waw files.
5. Write what you have heard when you played records 1, 2 and 3.

POINTS TO BE CAREFUL ABOUT

In lectures, we have placed the 0 frequency at the center of the plot. Matlab places the highest frequency at the center of the plot. You can convert between these two representations via the fftshift() function.. https://www.mathworks.com/help/matlab/ref/fftshift.html

You cannot print the fft of a signal, as it is complex. Instead, plot its magnitude (use abs() function of matlab).

Note that all filterings are done in the frequency domain. Multiplication by time is done at time domain.

SUBMISSION

Send your deliverables in a .zip file to the email address **cse348.mufe@gmail.com**. You can have group of two students.