

King Fahd University Of Petroleum & Minerals
 Department of Electrical Engineering
EE370-Communication Engineering I
2010-2011 Second Semester (102)

Project	Due Date: May 25, 2011
----------------	-------------------------------

Ser	Name	ID#	SEC#

Introduction

One approach in audio scrambling is to use spectrum inversion. In such a method, the baseband audio spectrum is rotated about its mean frequency which is about half the maximum audio frequency. The scrambled audio sounds unintelligible because high frequencies become low frequencies and vice versa. Figure 1 below shows a simple system that does spectrum inversion. The input signal, $m(t)$, is an audio signal. The LPF1 is used just to make sure that the audio signal has zero values above its maximum frequency, ω_c . The mixer is used to shift (left and right) the spectrum by ω_c . The LPF2 has a cutoff frequency of ω_c and is used to extract the required sides and produces the inverted spectrum. Please note that f_c and ω_c are used interchangeably.

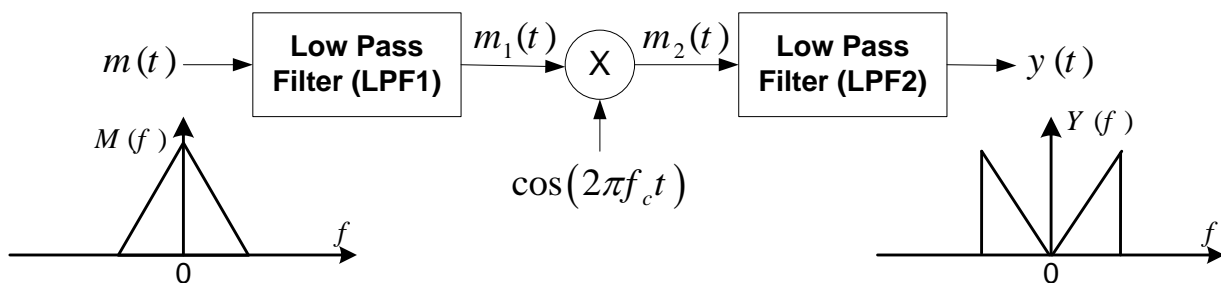


Figure 1: Spectrum Inversion System

Question

Part A:

Implement the above system in Matlab. Your code must do the following:
 Record your own voice. You may use 'wavrecord' and 'wavwrite' and 'sound' it in Matlab.
 For the LPFs, use 'butter' of order N and 'filter' in Matlab. Justify your choice of N ,
 Plot the spectrum of $m(t)$, $m_1(t)$, $m_2(t)$, and $y(t)$.
 Listen to $m(t)$ and $y(t)$ to compare them.
 Your code must be well-documented and the figures must be well labeled.

Part B:

Design and implement a system that does descrambling of $y(t)$.

Part C:

Submit a nice report about this project. It must include your code, plots, results, **discussion**, and conclusion in essay format.

- You should record your own voice and submit the recorded message when you submit the soft copy of the report & code.
- In addition to the main program, make the scrambler and descrambler as two separate functions. You may record a secret message and test the ability of your partner to descramble it. Also you can challenge other groups!
- Writing style and organization are very important (Quality not Quantity!)
- Work in groups of two (scrambler/descrambler)
- Try to learn from the project by examining the signal in the time and in frequency domain at different locations.
- Start early to avoid any last minute problem (Enjoy the Break!).
- Here are some nice excuses not to submit in time: the printer did not work, I have it in the flash, I do not know Matlab, I was busy with major exams,..... ☺