FREQUENCY MODULATION

INTRODUCTION

Frequency modulation (FM) is a modulation type in which the instantaneous frequency of the carrier is changed according to the message amplitude. The motive behind the frequency modulation was to develop a scheme with inherent ability to combat noise. The noise, being usually modeled as additive, has a negative effect on the amplitude by introducing unavoidable random variations which are superimposed on the desired signal. Unlike the amplitude, frequency has a latent immunity against noise. Since it resides "away" from the amplitude, any changes in the amplitude would be completely irrelevant to the frequency. In other words, there is no direct correlation between the variation in amplitude and frequency, thus making FM a better candidate over AM with respect to noise immunity. However, what FM gains in noise immunity lacks in bandwidth efficiency. Since FM usually occupies larger bandwidth, AM is considered more bandwidth wise.

AIM

In this experiment, we investigate the narrowband frequency modulation. Students are expected to:

1. Develop an appreciation of FM ability to counteract noise.
2. Be able to simulate the generation and the demodulation of NBFM using MATLAB.
3. To be able to tell the similarities and differences between AM and NBFM.

PROCEDURES

1. Use Matlab to read the attached audio file, which has a sampling frequency Fs=48 KHz. Find the spectrum of this signal (the signal in frequency domain). [*audioread, fft , fftshift , plot*]
2. Using an ideal Filter, remove all frequencies greater than 4 KHz.
3. Obtain the filtered signal in time domain, this is a band limited signal of BW=4KHz. *[ifftshift ,ifft*]
4. sound the filtered audio signal (make sure that there is only a small error in the filtered signal) [*sound*]
3. Generate the NBFM signal. Use a carrier frequency of 100kHz and a sampling frequency of $Fs = 5Fc$. Plot the resulting spectrum. What can you make out of the resulting plot?
4. what is the condition we needed to achieve NBFM.
5. Demodulate the NBFM signal using a differentiator and an ED. For the differentiator, you can use the following command: diff. Assume no noise is introduced.

USEFUL COMMANDS

audioread, fft, fftshift, ifft, ifftshift, awgn, resample, sound, hilbert, abs, mean, cumsum, diff.

REGULATIONS & REQUIREMENTS

- You could work in teams of two (2 students per team)
- Copied submissions will get ZERO (Note: the project will have a high weight from the total year works).
- Each team should submit **ONE PDF** report including your names and IDs, your obtained results (spectrum plots, waveforms, etc..), copy of the code, your answers and conclusions.
- Submission deadline: 10 June