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EE 430 – PROJECT PHASE 2 REPORT

Introduction

In this part of the project, desired information will be sent in audio environment and Frequency hopping frequency-shift keying (FSK) method will be used. During receiving and transmitting, laptop's loudspeaker and microphone will be used. The transmitted information will be any M-ary sequence. This M-ary sequence will be modulated using FSK modulation. In FSK modulation, each symbol is transmitted with a different tone of frequency.

General Schematic

In this project, we have three different carrier frequencies F1, F2, F3 and we have four different data frequencies f0, f1, f2, f3. Data frequencies corresponds to data symbol that are transmitted. For choosing these frequencies, we did some tests. Above 6 or 7 KHz, we couldn't get smooth results. When we look at the FFT of the signal, the computer couldn't show exact locations of these signals above 6 – 7 KHz. Therefore, frequencies determined as follows.

F1 = 1000	f0 = 0
F2 = 1800	f1 = 200
F3 = 2600	f2 = 400
	f3 = 600

Then all possible frequencies listed below and spectrogram of these signals are shown in Figure 1.

F1 + f0 = 1000	F2 + f0 = 1800	F3 + f0 = 2600
F1 + f1 = 1200	F2 + f1 = 2000	F3 + f1 = 2800
F1 + f2 = 1400	F2 + f2 = 2200	F3 + f2 = 3000
F1 + f3 = 1600	F2 + f3 = 2400	F3 + f3 = 3200

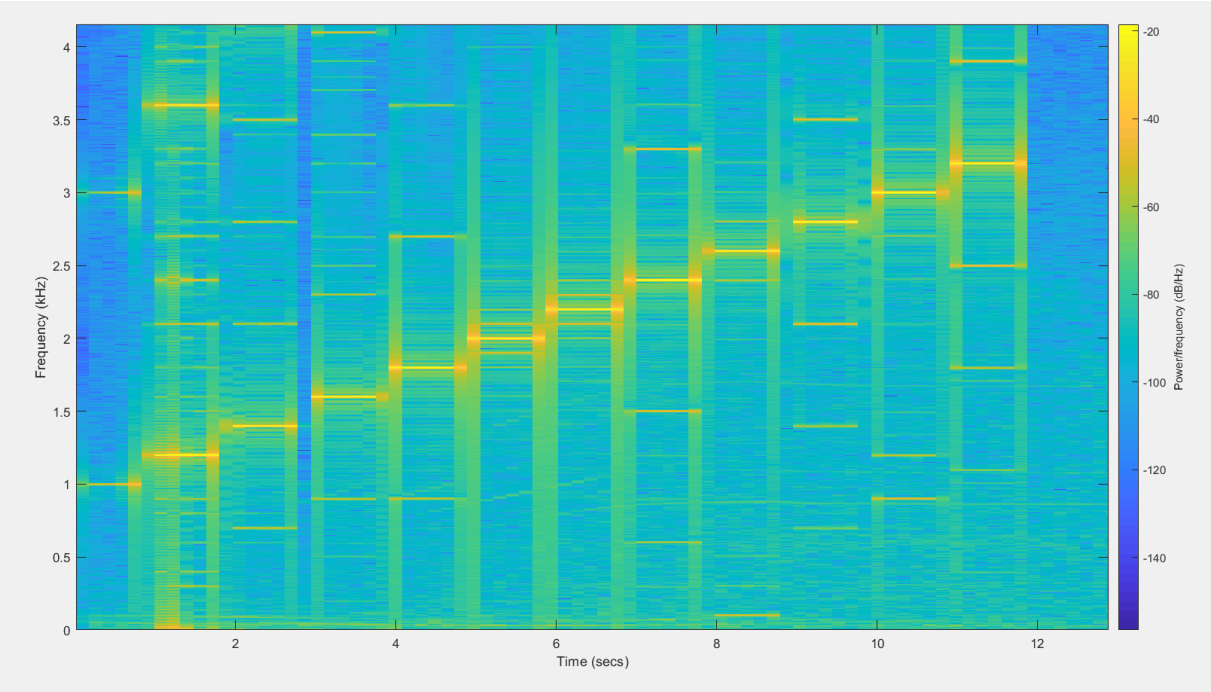

Figure 1. Spectrogram of test signal

Transmitter

In transmitter part, we enter some text from Matlab and we will send it as an audio. The transmitted signal is composed of different sinusoidal signals that have different frequencies. First of all, we have to teach carrier frequencies and data frequencies to receiver. Therefore, in the beginning of the transmitter, the test signal is transmitted. The test signal is composed of all 12 possible frequencies that we determined. Then, program asked to type the text to be transmitted and program convert each character of the text using ASCII codes into a binary sequence. And we assign every successive two bits to a frequency value.

[00] = 0 Hz [01] = 200 Hz [10] = 400 Hz [11] = 600 Hz

After getting binary sequence of input text and corresponding data frequency, carrier frequency is added to data frequency randomly. These frequencies are sent by sinusoidal signal i.e. we write these frequencies into the sinusoidal signal expression. Then, signals are compound by 'horzcat' command of Matlab. Finally, signal to be sent is obtained. And by using 'sound' command, signal is converted to audio.

Receiver

In receiver part, the input is an audio signal and the output is a text. First, the receiver learns the carrier and data frequencies from the test signal. Spectrogram is used for determining the frequency of the audio signal in particular time interval. From spectrogram, we get the frequency and time of the center of energy of each PSD or power spectrum estimate. Then, for each specific time interval maximum STFT is found and by using its location

in the output of spectrogram matrix, frequency value corresponds to that location is determined. Data frequencies are obtained and then we convert these data frequencies to binary codes. Finally, binary codes are converted to decimal and then decimal to char. Transmitted text is obtained properly.

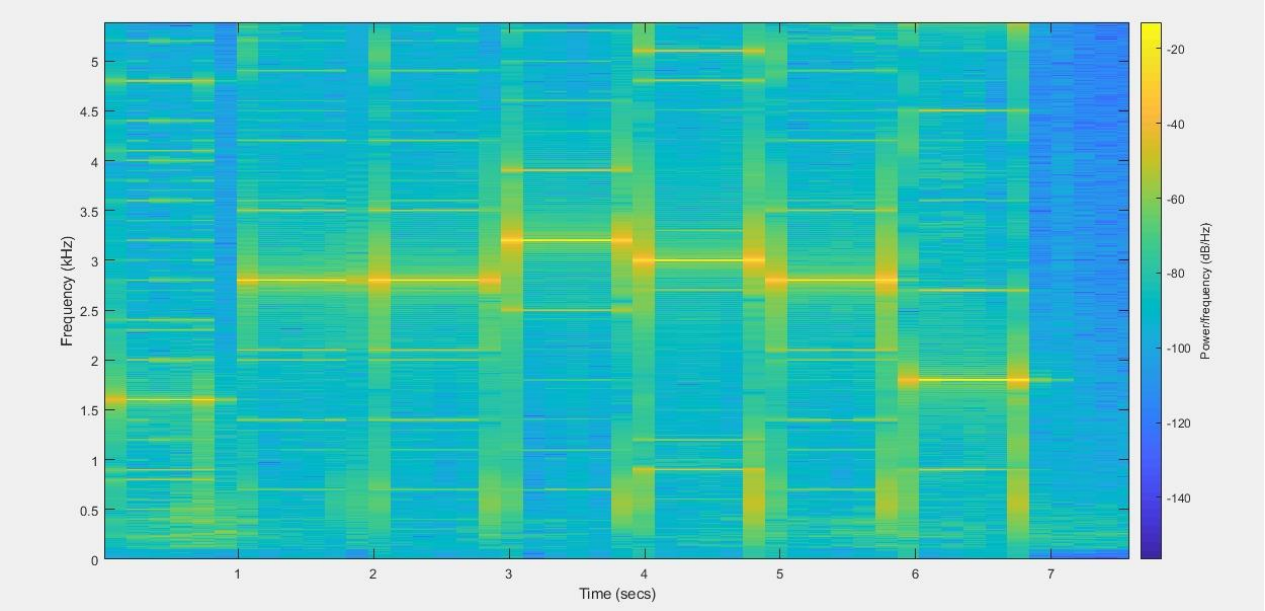

Figure 2. Spectrogram of received signal (text is ‘kd’)