EE432: Digital Signal Processing Fall 2008

Project 7: Real-time Processing & DTMF Decoding using the FFT

Assigned: Tues 10/21/08 Due: Mon 11/3/08

This project is intended to give you more experience in using the FFT and analyzing its results.

I. Real-time Signal Capture and Display

1. Download the *daq_minidemo.m* file from the course website (under Projects). Change the program so that the lower window displays the magnitude of the FFT of the current set of samples in dB ($X_{dB} = 10 \log_{10} X$). Ensure the frequency axis is accurate.

2. You will probably have to adjust the displayed axis on the upper plot, as the y-limits depend on your hardware setup. You will also have to determine a good set of y-axis limits for the dB value, such as for example -50 dB to + 10 dB (so the y-axis limits would be -50 and 10.

3. Demonstrate your revised *daq_minidemo.m* running to me by speaking into the microphone. What are the approximate ranges of frequencies of your voice as you speak? Be sure I initial this sheet here, so I'll know that you successfully demonstrated your real-time program to me: _____.

II. Decoding a set of DTMF Tones using the FFT

Download the "UnknownDTMFs.wav" file from the course website. Do NOT assume the sample frequency is 8000 Hz. Write a MATLAB program that will take this file and determine the individual DTMF digits within the file. You can use the example in the last section of the Etter/Ives notes as a guide. The general steps are as follows:

1. Compute the average power in small non-overlapping windows (use 50 samples).

2. Use average power to automatically determine the starting points to collect samples for the FFT.

3. Compute and decode the FFTs to determine the digits. Note that there are 11 digits in the file, so overall, this program will be computing and decoding 11 FFTs.

4. Provide a plot like Figure 3-44, which is a 3x1 subplot: (1) original signal; (2) average power computations; and (3) identification of portions of the signal which are DTMF tones and the portions which are not.

5. Provide 2 plots like Figure 3-46, which shows the magnitude of the FFT <u>AND</u> the location of the high/low group frequencies on the axis. Since there are 11 FFTs, put them in the two plots: (1) a 6x1 subplot and (2) a 5x1 subplot.

		High-Group Frequencies			
		1209Hz	1336Hz	1477Hz	1633Hz
Low-Group Frequencies	697Hz	1	ABC 2	DEF 3	A
	770Hz	GHI 4	JKL 5	MNO 6	B
	852Hz	PRS 7	TUV 8	WXY 9	C
	941Hz	*	OPER 0	#	D

For this lab's write up, demonstrate your Part I to the professor (initial above), and turn in your code and the required plots for Part II.