EE 443 Design and Application of Digital Signal Processors

Homework Assignment #1, Spring 2016

Report Due: April 7, 2016

Demo: afternoon of April 7, 2016

Home Assignment Grading Policy

- Assignments are graded on a group basis.
- Grades are based on both written reports and demos.
- Demos have to be presented to TA on the signed up slot. No late demo

Submission Instructions

- Capture the images or take the pictures and add to your report
- The report cover page should have: homework number, student name, and student number.

Problem 1: Based on the example, Sine8_LED.c Sine generation with DIP switch control, given in the lecture note 2, generate an 800Hz sine wave with an 8KHz sampling rate (10 samples per period) and output to the LINEOUT jack of the AIC23 daughter card. Use an oscilloscope attached to the LINEOUT jack to verify. Also take advantage of the data exporting via UART (see the example in Lecture Note 1 about transferring a chunk of data to Matlab via UART), use the appropriate Matlab command to plot the 256 most recent output samples in the time domain, as well as the FFT magnitudes of these 256 samples.

Problem 2: Use a tone generator (http://onlinetonegenerator.com/) to generate 2 sinusoidal waves separately; one at 3KHz and the other at 6KHz. Set the sampling frequency of the AIC to 8KHz. Use the loopback function to output each wave to the oscilloscope (individually since there is only one jack) and plot the time and frequency domains (512 samples) in Matlab. Save the data and compare the two results. Explain what you observe.

Problem 3: Write a C program that generates the following multi-component signal: use 32KHz as a sampling frequency

$$x(t) = \alpha \sin(2\pi f_1 t) + \beta \sin(2\pi f_2 t) + \gamma \sin(2\pi f_3 t)$$

where *f1, f2*, and *f3* are 3.2KHz, 4.8KHz, and 8KHz respectively. The user can change the magnitudes of each frequency components α, β, and γ using the switches on the DE2i-150 board. We recommend assigning two switches to each of these variables (i.e., switches 1,2 to α , switches 3,4 to β, and switches 5,6 to γ) and determine the values of α, β, and γ as a 0 (sw=00), 1 (sw=01), 2 (sw=10), or 3 (sw=11) to the frequencies respectively. Output the generated signal to the oscilloscope and plot the time and frequency domains (512 samples) in Matlab.

Problem 4: Write a C program to make music player controller. Your program should continuously receive music (say from youtube) from stereo LINE inputs and output the LEFT and/or RIGHT channels of music if switches 1 and/or 2 is up and turn LED1 and/or LED2 ON separately. If switches 1 and/or 2 is down separately, then stop the LEFT and/or RIGHT channels of music and turn LED1 and/or LED2 OFF separately. Use 44 KHz as a sampling frequency.

Problem 5: Write a program to generate a square wave using a sine wave as input (from the tone generator). The program should test if the input is greater than or equal to a variable *accum* (initially 0)*,* in which case the output is a positive scaled value, where *accum* accumulates with a positive step size value. If not, the output is a negative scaled value and *accum* accumulates with a negative step size value. Choose a step size value of 2*pi*f/Fs, using f = 1kHz as the input signal frequency and Fs = 8kHz as the sampling frequency. Cast the step size and *accum*. Verify the output square-wave signal by using the oscilloscope and the 512 points of plot in Matlab.