MAS.160 / MAS.510 / MAS.511 Signals, Systems and Information for Media Technology
Fall 2007

MAS160: Signals, Systems & Information for Media Technology

Problem Set 6

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Problem 1: Frequency response of FIR filters (*DSP First* 6.4)

Problem 2: Simple sound filtering

Using our old friend the `sumcos` function, create a sound with a fundamental frequency of 440 Hz, with 12 harmonics of equal amplitude and zero phase, and using the following parameters:

```
fs = 11025;         % Sets sampling rate to 11025 Hz
f = 440*[1:12];     % Creates frequency vector of 12 harmonics of 440 Hz
X = ones(1,12);     % Creates amplitudes of 1
dur = 1;            % Sets duration to be 1 sec
```

Use MATLAB to perform the following tasks:

(a) Create a three-point averaging FIR filter and plot the frequency response (magnitude and phase) of this filter using `freqz`. What is this filter supposed to do? Filter the sound you created above with this filter. How does it compare to the original sound?

(b) Create a two-point first difference FIR filter and plot the frequency response (magnitude and phase) of this filter using `freqz`. What is this filter supposed to do? Filter the original sound you created above using this new filter. How does it compare to the original sound?

Problem 3: Return of the Labs: *DSP First* Lab 5

Items to be turned in:

(a) Plots and answers to questions specified in C.5.2.1.

(b) Plots and answers to questions specified in C.5.3.2.

(c) Demonstrate linearity and time-invariance of filter (C.5.3.3 and C.5.3.4).

(d) Plots and answers to questions specified in C.5.3.5.

Problem 4: Additional Problem (for MAS.510)

The MATLAB function `zplane` is great for plotting the poles and zeros of a system in the z-plane. Use `zplane` as well as `freqz` to answer the following questions.

(a) Consider the general N-point FIR averaging filter, where each coefficient b_k is simply $\frac{1}{N}$. Plot the zeros of this system in the z-plane as well as the frequency response (magnitude and phase) for $N = 3$, 4, 5, and 10. How does the position of the zeros change? Qualitatively, how does the frequency response change, and how does this relate to the location of the zeros? Does N being an even or odd number have any effect?

(b) Consider the general N-point FIR difference filter, where each coefficient b_k is simply $\frac{(-1)^k}{N}$. Plot the zeros of this system in the z-plane as well as the frequency response (magnitude and phase) for $N = 3$, 4, 5, and 10. How does the position of the zeros change? Qualitatively, how does the frequency response change, and how does this relate to the location of the zeros? Does N being an even or odd number have any effect?