Agenda CENG 3315 February 2, 2022

Turn in HW1
Note: Please be neater (Some of you). Do the problems on scratch paper and copy to your HW to turn in to me. Thanks

When a value has a unit – include the unit, i.e. .45 ms. (It can help a lot to avoid mistakes in some problems.)

START CHAPTER 3

1 RUN the Magic MATLAB Square Wave

```
%% CODE from M-file FourierSeriestest1.m   A square wave
A (T=2*pi)
%% Show 3 terms and then 51 odd terms to N=101
% PRESS A KEY WHEN VIEWING FIGURE!
```

Describe Code

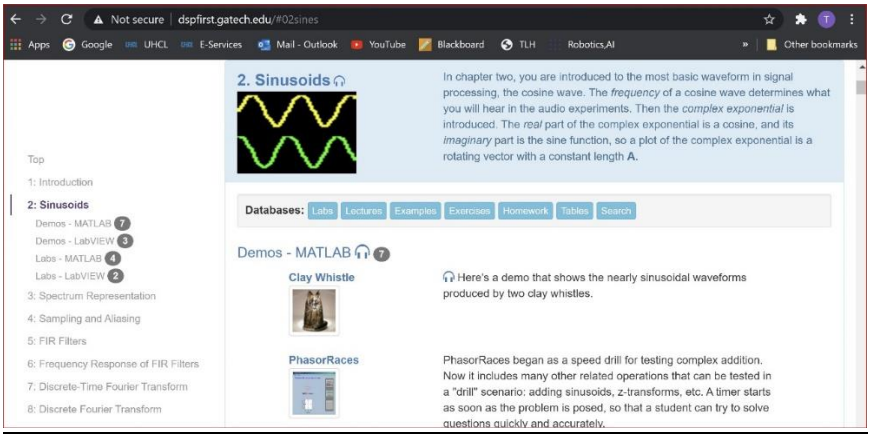
MATLAB_Fourier_SquareWave

Lectures3_4Harmonics_L6 Lecture3_5_1_Fourier_L07

Ch3_FourierSeries&TLH_Ch8_4

DSPF_website (7b)

http://dspfirst.gatech.edu/



Beat Notes/FM/Rotating Phasors/Spectrogram - sounds

https://dspfirst.gatech.edu/chapters/03spect/demos/beatcon/index.html

Beat Notes and beatcon.m

An interesting situation occurs when we have two sinusoidal signals of slightly different frequencies; i.e.,

$$x(t)=A\cos(2\pi(f_c-\Delta f)t)+B\cos(2\pi(f_c+\Delta f)t)$$

When $A=B$ the signal can be written as a product:

$$x(t)=2A\cos(2\pi(f_c)t)\cos(2\pi(\Delta f)t)$$

and the resulting signal is called a beat note signal. With the **Beatcon Demo** you are able to generate $x(t)$ for various values of f_c, Δf, A and B.
Here are three sounds to study. First listen to each of them without knowing what they are.

Can you distinguish two signal components? A high(er) frequency sinusoid and a slowly changing one which might sound like the signal is fading in and out.

https://dspfirst.gatech.edu/chapters/03spect/demos/fmsynth/index.html

The general equation for an FM sound synthesizer is:

$$x(t) = A(t)\cos[\omega_c t + I(t)\cos(\omega_m t + \phi_m) + \phi_c] \qquad (1)$$

PLAY THE SOUNDS ON DSPF

Below are some examples of sounds that can be synthesized with the appropriate choice of $A(t)$, $I(t)$, ω_c, and ω_m. These sounds were originally synthesized by Robbie Griffin.

Instrument	Carrier Frequency (Hz)	Modulating Frequency (Hz)	Audio
Brass	900	300	0:00 / 0:00
Clarinet	900	600	0:00 / 0:00
Bell	110	210	0:00 / 0:10
Knocking Sound	80	55	0:00 / 0:01

[1] John M. Chowning, "The Synthesis of Complex Audio Spectra by means of Frequency Modulation," *Journal of the Audio Engineering Society*, vol. 21, no. 7, Sept. 1973, pp. 526–534.