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Lab 2 Part 1
Due May 23, 2017
EEL3135

Lab 2: More Sinusoids

Lab Part One

In this section, you will write a function called syn_sin.m that will synthesize a waveform from the vectors of frequencies and complex amplitudes. You must write the function with one loop. Below is a template that you should base your solution on.

Your function will take in two vectors of the same length: a vector of frequencies and a vector of phasors, along with numbers for sampling frequency fs, duration dur, and start time tstart. Adapt your code, from the one_cos function in your last lab, to now process these arguments, generate a sinusoid for each frequency and phasor in the two vectors and add them together.

Function syn_sin.m

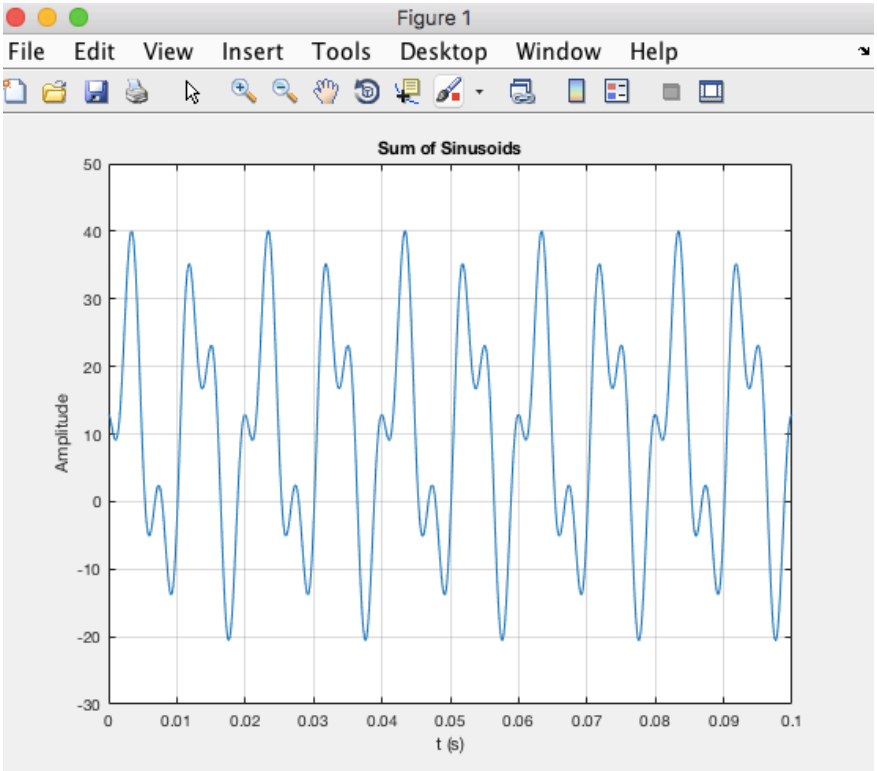
```
function [ xx, tt ] = syn_sin(fk, Xk, fs, dur, tstart)
%{
    syn_sin - Function to synthesize a sum of cosine waves.

usage:
    [xx, tt] = syn_sin(fk, Xk, fs, dur, tstart)
    fk = vector of frequencies (could be negative or positive)
    Xk = vector of complex amplitudes: A*e^(j*phi) for each fk
    fs = the number of samples per second for the time axis
    dur = total time duration of the signal
    tstart = starting time (default is 0, if you make this input
optional)

    xx = vector of sinusoidal values
    tt = vector of times, for the time axis

    Note: fk and Xk must be the same length:
    Xk(1) corresponds to frequency fk(1),
    Xk(2) corresponds to frequency fk(2), etc.

    More notes:
    exp is exponential form
    real(X) is the real part of X - i/j complex numbers
    imag(X) is the imaginary part of X - i/j complex numbers
%}
```

```
    % (Step 1) take in two vectors of same length, frequency and
phasor, fk, Xk,
    Lf = length(fk); % length of fk
    LX = length(Xk); % length of Xk
    n = length(Xk); % length of Xk, vector of complex amplitudes
    xx = zeros(1,(dur-tstart)*fs+1); % vector of sine values, 1 to
length * number of samples + 1

    % error checking length to make sure fk and Xk are equal
    if(Lf ~= LX)
        error('Xk must have same length as fk')
    end
    % check number of arguments user gives function, if less than 5,
tstart
        % defaults to 0
    if nargin < 5, tstart = 0, end

    % single for loop
    % (Step 3) base for loop off of one_cos function
    for k = 1:n % from 1 to length(Xk), vector of complex amplitudes
        % (Step 2) take in numbers for sampling frequency fs, duration
dur,
            % start time tstart
        tt = tstart:(1/fs):dur; % vector of times, start to end by
samples/sec
        % (Step 4) generate sinusoid for each frequency and phasor, fk
and Xk
        yy(:,k) = Xk(k)*exp(j*2*pi*fk(k)*tt); % Euler's phasor form
function equation, k'th, 1:n, column of yy
        a = real(yy); % real part of yy
        b = imag(yy); % imaginary part of yy
        xx = xx + a(:,k)' + b(:,k)'; % (Step 5) vector of frequencies +
vector of phasors
    end

    % plot
    plot(tt,xx) % plot time vs sine waves
    xlabel('t (s)')
    ylabel('Amplitude')
    title('Sum of Sinusoids')
    grid on;
end
```

Testing:

Try the following test and plot the resulting sinusoid:
[xx0,tt0] = syn_sin([0,100,250], [10,14*exp(-j*pi/3), 8*j],10000,0.1,0);

>> [xx0,tt0] = syn_sin([0,100,250], [10,14*exp(-j*pi/3), 8*j],10000,0.1,0);



(a) Measure the period xx0 by hand.
(b) Compare the period of xx0 to the periods of the three individual signals that make up xx0.
(c) Why is the period of xx0 longer than the two sinusoids?

(a) gcd(0,100,250)

- 2 * 50 = 100
- 5 * 50 = 250
- f = 50 Hz
  - fundamental period T_o = 1/f = 1/50 = 0.02ms

(b) The period of xx0 is larger than the period of the individual signals that make up xx0.

(c) This is because the period of xx0 is the sum of the three individual signals added together.