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1 %{
2 Aidan Chin M5 9/29/23
3 ECE 202 MATLAB Exercise M5
4 The goal of this code is to demonstrate that the product of 2 sinusoids can
5 be written as the sum of 2 sinusoids
6
7 Essentially using Product to Sum Identity of Sinusoids
8 ---- cos(a)*cos(b) = 1/2(cos(a+b) + cos(a-b)) ----
9 Citation for formulas: http://hyperphysics.phy-astr.gsu.edu/hbase/trid.html
10 %}
11
12 % *** Prepare workspace ***
13 clear % clear variables to remove chance of error
14 clf % clear figures to make the graph window clear
15
16
17 % *** Givens ***
18 tmax = -.1; % minimum time, in seconds (s)
19 tmin = .1; % maximum time, in seconds (s)
20 N = 400; % number of steps in the graph
21 t = linspace(tmax,tmin,N+1); % create array of N+1 numbers between tmax and tmin
22
23
24 % *** Calculation ***
25 a = 40.*t - 1.2; % inside value for first cos
26 b = 60.*t + 1.8; % inside value for second cos
27 f = 10 * cos(a) .* cos(b); % given cosine multiplication formula
28 f1 = 5 * cos(a+b); % first term in equivalent addition formula
29 f2 = 5 * cos(a-b); % second term in equivalent addition formula
30 tms = t.*1000; % convert seconds to miliseconds (more readable)
31
32
33 % *** Check ***
34 d = abs(f1+f2) - abs(f); % check to make sure the 2 formulas are equivalent
35 check = sum(d) % print single number check, should be close to 0
36
37 % the reason we use abs instead of solely sum is because you want to find the
38 % distance of the 2 graphs from each other, and distance is always positive
39
40 % *** Graphing ***
41 plot(tms,f,tms,f1,tms,f2,tms,d,'linewidth',2)
42 %plot all 3 formulas and check on one graph with linewidth 2
43 title({'Showing That 10*cos(40t-1.2)*cos(60t+1.8)' ...
44       'Could Be Written As' ...
45       '5*cos(40t-1.2 - 60t+1.8) + 5*cos(40t-1.2 - 60t + 1.8)'}))
46 % make a 3 line title
47 legend('f = [10 * cos(40t-1.2) * cos(60t+1.8)]', ...
48        'f1 = [5 * cos(40t-1.2 + 60t+1.8)]','f2 = [5 * cos(40t-1.2 - 60t+1.8)]', ...
49        'Check = [|f1+f2| - |f|], should be 0')
50 % make a legend for each graphed line
51 ylabel('Voltage (V)') % change y axis label
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52 xlabel('Time (ms)') % change x axis label
53 ylim([-11,11]) % change y limits in graph to prevent overlap with the legend
54 grid on % enable grid on graph
55
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>> M5
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check =
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-8.1324e-15
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>>
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Showing That  $10 \cdot \cos(40t - 1.2) \cdot \cos(60t + 1.8)$   
Could Be Written As  
 $5 \cdot \cos(40t - 1.2 - 60t + 1.8) + 5 \cdot \cos(40t - 1.2 - 60t + 1.8)$

