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1 % Ian Woodbury
2 % 10/27/21
3 % ECE 202 Fall 2021 MATLAB Exercise M5
4 % Turning the product of two sinusoids into the sum of two sinusoids,
5 % And graph all three functions together to show the difference
6 % formulas found at http://hyperphysics.phy-astr.gsu.edu/hbase/trid.html
7
8 clear
9
10 clf
11
12 % ----- Declaring Each function -----
13
14 tm = linspace(-100, 100, 400); % sets up t as the x-axis, and 400 points to
15 % plot each equation with, units in milliseconds(ms)
16 t = tm/1000; % converts tm from milliseconds to seconds for calculations
17
18 a = 80*t+1.2; % a and b are the parts of the sinusoid, declared
19 b = 120*t-1.8; % here to shorten code later on, as they will be used
20 % frequently
21 k = 15; % constant at the beginning of the sinusoid given
22
23 f = k*cos(a).*cos(b); % the sunusoids multiplied together,
24 % as a function over t
25 f1 = (1/2)*k*cos(a+b); % f1 and f2 are partial equations to be used later,
26 f2 = (1/2)*k*cos(a-b); % and work as functions over t
27
28 % ----- Checking and Plotting -----
29
30 df = f-(f1+f2); % checks for the difference between the original function
31 % and the two sum equations as an array of values over t
32 % difference should come out to zero over all values of t
33
34 plot(tm, f, "r", tm, f1, "g", tm, f2, "b", tm, df, "black", "LineWidth", 3)
35 % plots f, f1, f2, and df in red, green, blue, and black respectively
36 axis([-inf inf -15 25]) % makes the axis -15 to 25, as room for a legend
37 grid on
38 ax.GridAlpha = 0.3; % Makes grid darker
39 legend('f : Product Function', 'f1 : First Sinusoid', ....
40 'f2 : Second Sinusoid', 'df : f - (f1 + f2), should be zero', 'FontSize', 16)
41 % extra spaces in f's label to make semi colons line up in the legend
42 set(gca, 'FontSize', 14) % sets the font size for axis values
43 xlabel('time t (ms)', 'FontSize', 14); % label for the x axis, w/ units
44 ylabel('f(t)', 'FontSize', 14); % label for y axis
45 title("ECE 202 MATLAB Exercise M5: Rewriting the product \newline of two" ...
46 + " sinusoids into the sum of two sinusoids", 'FontSize', 20)
47
48 % final check to prove the df array is all zero values
49 check_array = sum(abs(df)) % should print out zero, or a number very close to
50 % zero, (due to floating point errors) if the design is correct
51 % abs function used to make every value summed the same sign for accuracy
52 % in calculations
53
54 % The graph of df shows that all values line up on the x axis, which is zero
55 % This proves the sum functions added equal to the product functions
56 % multiplied too, as the difference between them is zero, or none
57 % dfcheck also comes out to a value close to zero, further proving the
58 % design to be successful too.
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