Homework #11

Isaac Ayala Lozano

2020-03-24

The spectra of frequencies is evaluated for several equations. The follwoing sections present the results for each function evaluated. The samplig frequency for all tests was 10 Hz.

1. Exponential functions

For the function

$$x(t) = \begin{cases} A\exp(-\alpha t) & t \geq 0 \\ 0 & t < 0 \end{cases}$$

the results are shown in Figure 1. The parameters for the simulation were

- A =2
- $\alpha = 5$

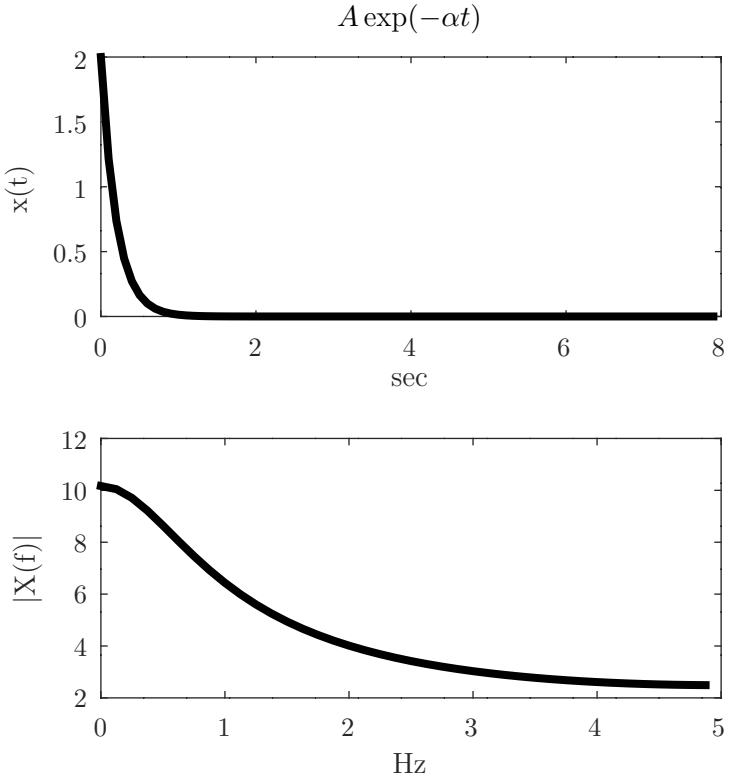

Figura 1: Exponential function.

2. Trigonometric functions

Given a function of the form

$$x(t) = \begin{cases} A\exp(-\alpha t)\cos(bt) & t \geq 0 \\ 0 & t < 0 \end{cases}$$

the graph obtained is similar to the one presented in Figure 2. The parameters for the simulation are:

- A =2
- $\alpha = 5$
- $b = 10$

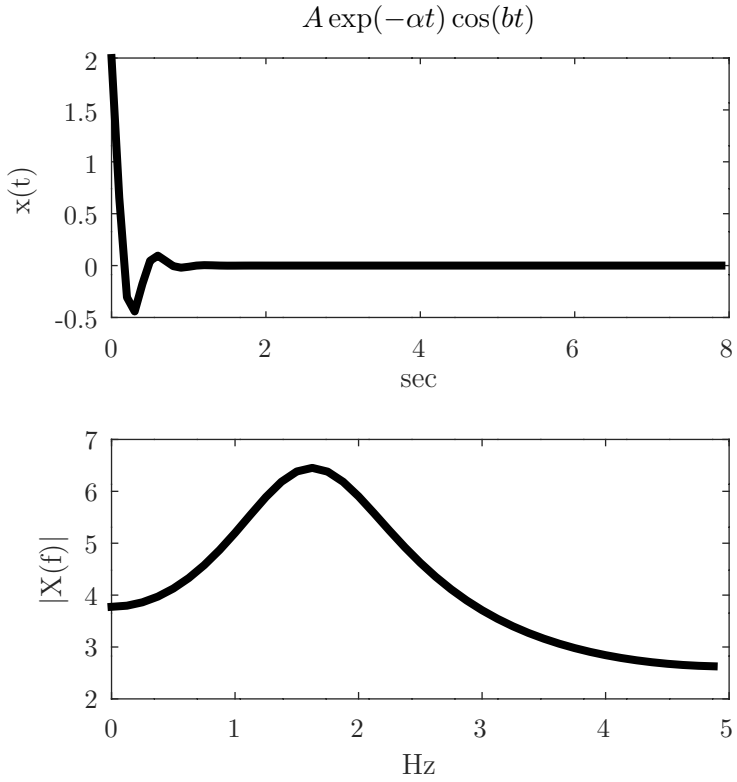

Figura 2: Trigonometric function.

3. Cosntant coefficients and step functions

Given a function of the form

$$x(t) = \begin{cases} A & c \geq t \geq 0 \\ 0 & c < t < 0 \end{cases}$$

where

- A =2
- $c = 5$

the results of such function are presented in Figure 3.

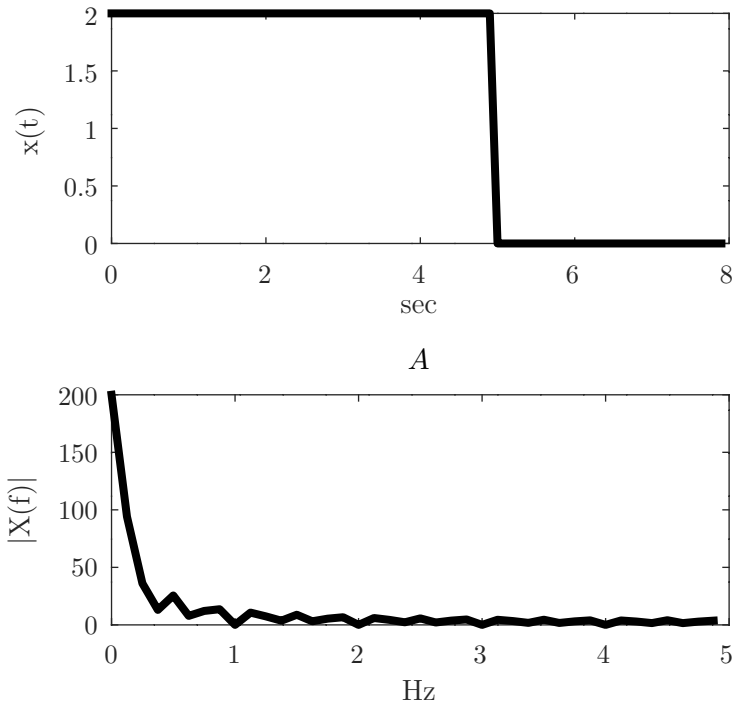

Figura 3: Constant coefficients.

A. Octave Code

```
clear all
close all
clc

Fs = 10;                    % Sampling frequency
T = 1/Fs;                     % Sampling period
L = 80;                     % Length of signal
t = (0:L-1)*T;
lim = L/2;                          %FFT Array size
f = Fs*(0:((L)/2))/L;               %frequency vector
A = 2;
alpha = 5;
b = 10;
c = 5;

```

```
16 %% Time signals
17 S1 = A * exp(- alpha *t);
18 S2 = A * exp(- alpha *t) .* cos(b*t);
19 S3 = zeros(L,1);
20
21  for i =1:L
22   if (i*T <= c)
23     S3(i) = A;
24     endif
25   endfor
26 %% FFT
27 X1 = abs(fft(S1));
28 X2 = abs(fft(S2));
29 X3 = abs(fft(S3));
30
31 X1 = 2*X1(1:lim);
32 X2 = 2*X2(1:lim);
33 X3 = 2*X3(1:lim);
34
35 figure(1)
36 subplot(2,1,1)
37 plot(t,S1, 'k','linewidth', 3)
38 title('$A \exp (-\alpha t)$','Interpreter','latex')
39 xlabel('sec','Interpreter','latex')
40 ylabel('x(t)','Interpreter','latex')
41 subplot(2,1,2)
42 plot(f(1:lim), X1, 'k','linewidth', 3)
43 xlabel('Hz','Interpreter','latex')
44 ylabel('|X(f)|','Interpreter','latex')
45
46 %%print('-dpdflatex', './img/hw11_exp.tex', '-S300
     ,300');
47
48 figure(2)
49 subplot(2,1,1)
50 plot(t,S2, 'k','linewidth', 3)
51 title('$A \exp(-\alpha t) \cos (bt)$','Interpreter','
     latex')
52 xlabel('sec','Interpreter','latex')
53 ylabel('x(t)','Interpreter','latex')
54 subplot(2,1,2)
```

```
55 plot(f(1:lim), X2, 'k','linewidth', 3)
56 xlabel('Hz','Interpreter','latex')
57 ylabel('|X(f)|','Interpreter','latex')
58
59 %%print('-dpdflatex', './img/hw11_cos.tex', '-S300
      ,300');
60
61 figure(3)
62
63 subplot(2,1,1)
64 plot(t,S3, 'k','linewidth', 3)
65 xlabel('sec','Interpreter','latex')
66 ylabel('x(t)','Interpreter','latex')
67 subplot(2,1,2)
68 plot(f(1:lim), X3, 'k','linewidth', 3)
69 title('$A$','Interpreter','latex')
70 xlabel('Hz','Interpreter','latex')
71 ylabel('|X(f)|','Interpreter','latex')
72
73 %%print('-dpdflatex', './img/hw11_A.tex', '-S300,300')
      ;
```