ELEC-A5204 Homework 1

13.8.2019

Answer to all questions in given Matlab files and use Matlabs publish feature to generate a pdf file. Always return the published pdf AND Matlab files. Task are also written to Exercise1 X.m files which can be downloaded from Mycourses. When an exercise ask you to draw figures, return them always with suitable axis labels and titles.

1 Signal generation and audio stuff

a) What is the sampling frequency of *signal*?
How long the *signal* is in second?
What are the maximum and minimum values of the *signal* and corresponding indexes that those values occur?

b) Generate a signal named $signal_a$ that is same as *signal* but it is reversed and scaled to 1.

c) Generate a vector that is equally long as *signal* that grows linearly from 0 to 1 and element-wise multiply *signal* with it to generate $signal_b$. Scale $signal_b$ also to 1.

2 Some basic signal processing functions

a) Write your own sinc function called $sinc_{own}$ to the end of the script and plot it using time vector t_a to figure(1).

b) Write your own digital diracs delta funktion $\delta[n]$ and digital step function $\mu[n]$ at the end of this script. Then use stem() to draw your own diracs delda function and plot() for your step function.

3 Sampling theory

A pure sinusoidal sequence can be written as: $x[n] = A\cos(\omega n + \theta) = A\cos(2\pi f/f_s n + \theta)$, where $\omega = 2\pi f/f_s$ is normalized angular frequency with frequency f and sampling frequency f_s , A is amplitude, and θ is phase shift.
A code for generating signal:

```
n = [-2 : 15];
A = 1;
theta = 0;
omega = 0.2*pi;
x = A * cos(omega * n + theta);
figure(1); clf; % open/activate Fig. 1, clean it
stem(n,x);
axis([-1.5 10.5 -1.1 1.1]); % zoom [xmin xmax ymin ymax]
grid on; xlabel('n'); ylabel('x[n]'); title('Sequence x[n]');
```

a) The sampling frequency tells us how many samples there are during one second. (How many values have been sampled in one second.) If the sampling frequency $f_s = 10000$ Hz, (I) how many samples are they in 0.5 seconds? (II) how long would 20000 samples last in seconds?

b) Generate a pure sinusoidal sequence whose frequency is f = 440 Hz, amplitude A = 2, length is 0.5 seconds, and sampling frequency is $f_s = 16000$ Hz. Visualize it with stem and plot so that figure shows signal from 0 to 0.02 seconds, and listen with soundsc(x, fs).

c) Do the same as in b) but now f = 15560 Hz.