Lab/Tutorial Session No. 10

ELE532 : Signals and Systems I

Agenda

1st part: Lab No. 4

2nd part: Lab Work

Lab 4

November December	Monday	Tuesday	Wednesday	Thursday	Friday
1st hr: Tutorial **2nd hr: LAB 4**	16	17	18	19	20
LAB 4 (hand-in by Nov. 29)	23 Sec. 6 Demo Lab 4	24 **Quiz 4**	25	26	27 Sec. 1 & 5 Demo Lab 4
Tutorial	30	1 *Last lecture*	2	3	4

Due Date: November 29th at 11:59 PM

Demo (20%): Before the due date.

Lab 4

Purpose:

- Application of Fourier Transforms for time waveforms analysis.
- Design and implement a communication system.

Fourier series: Periodic signals

$$D_n = \frac{1}{T_0}\int_{<T_0>} x_p(t)e^{-j\omega_0 nt}dt \longleftrightarrow x_p = \sum D_n e^{j\omega_0 nt}$$

← In lab 3

Fourier transform: More signals (including periodic ones)

$$X(j\omega) = \int_{-\infty}^{\infty} x(t)e^{-j\omega t}dt \longleftrightarrow x(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} X(j\omega)e^{j\omega t}d\omega$$

← In lab 4

Read more at:
https://www.ee.ryerson.ca/~courses/ss1/Topic9_pdf.html

Lab 4

Purpose:

- Application of Fourier Transforms for time waveforms analysis.
- Design and implement a communication system.

```
Xf = fft(x);
```
← Fourier transform

```
fftshift(  abs(Xf))
fftshift(angle(Xf))
```
← helps center the spectrum at the origin

```
xhat = ifft(Xf);
```
← inverse Fourier transform

Lab 4 - A

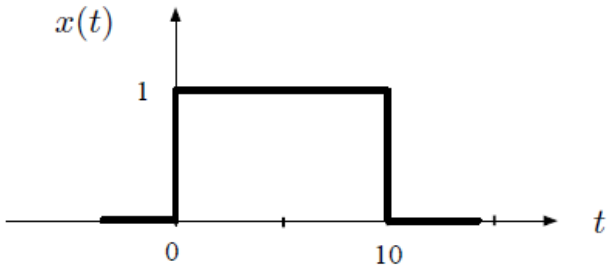


Figure 1: Single pulse signal $x(t)$.

A.1: (handwritten)

- Compute z(t) = x(t) * x(t) ← Time-domain operation
- Then plot!
  - Do not forget axis labels , title

A.2: (MATLAB)

- Compute Z(ω) = X(ω)X(ω) ← Frequency-domain operation

Lab 4 - A

A.3: (MATLAB)

- Plot magnitude + phase spectra of z(t)
- Use “stem()” instead of plot()

A.4: (MATLAB)

(convolution z(t)=x(t)*x(t)) (Fourier Z(w)=X(w)X(w))

- Implement z(t) in time-domain & frequency-domain operations
- Compare with results in A.1
- Answer discussion questions!

Lab 4 - A

A.5: (MATLAB)

- Get FT of x(t) and plot magnitude- & phase- spectra when:
  - Pulse width of x(t) = 5
  - Pulse width x(t) = 25

- Observe, compare, explain FT property based on the results you got

Lab 4 - A

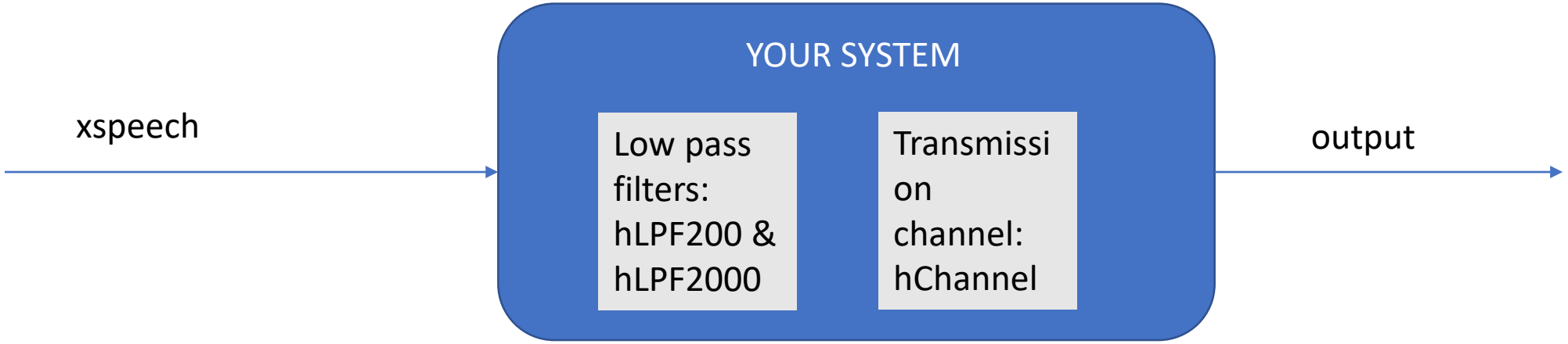
A.6: (MATLAB)

- Get FT of the following, and plot magnitude- & phase- spectra:

$$w_+(t) = x(t)e^{j(\pi/3)t}$$
$$w_-(t) = x(t)e^{-j(\pi/3)t}$$
$$w_c(t) = x(t)\cos(\pi/3)t.$$

- Observe, compare, explain FT property based on the results you got

Lab 4 - B



- Detailed Block Diagram of your coder and decoder.
- Implementation of coder and decoder.
- Explanation of your design.

[No help with part B this time]

Other Reminders

How you should submit your Lab:

- Standard cover page + Lab report => 1 PDF file (Lab3_Student1_Student2.pdf)

- All MATLAB Files = > one zip file (Lab2_Student1_Student2.zip)