ELG3125 Signal and System Analysis

Frequency Content of Continuous-Time Signal

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Slides and assignments:
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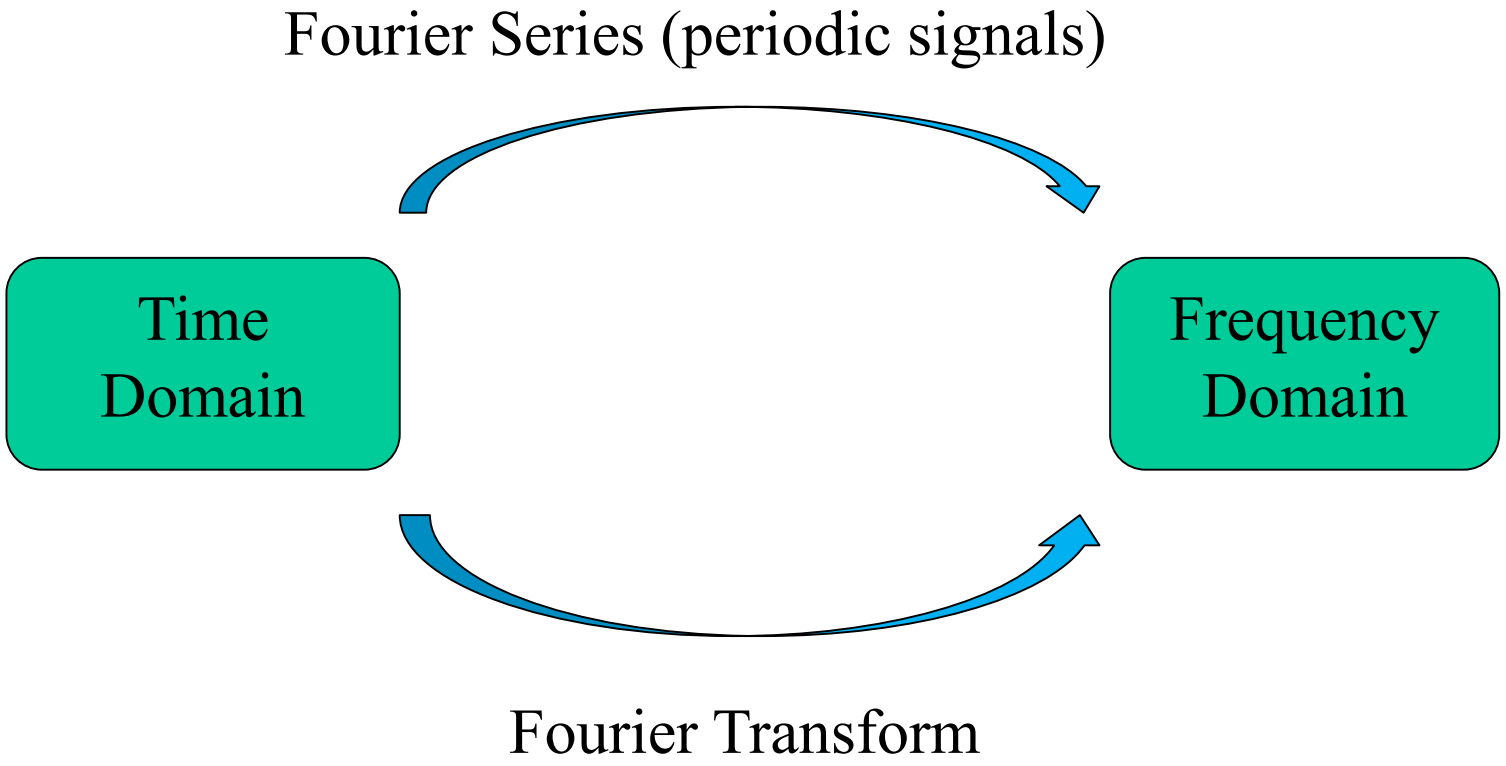
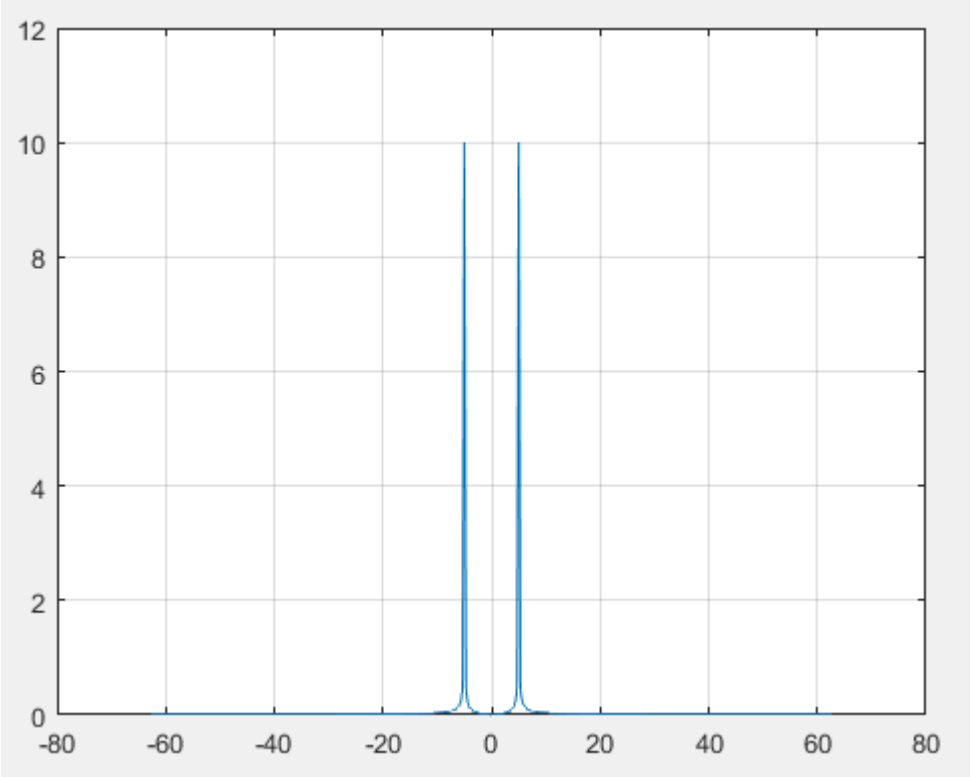
Frequency Content



*Fourier Transform in MATLab can be obtained by fft().
**There is a relationship between Fourier Series and Fourier Transform.

Fourier Transform of sin(5t)

```
dt = .05;
t = -10:dt:10;
x = sin(5*t);
X = fft(x)*dt;
X = fftshift(X);
Nw = length(X);
k = -(Nw-1)/2:1:(Nw-1)/2;
w = k*2*pi/Nw/dt; %rad./sample
plot(w,abs(X)); grid on;
```



Frequency response of the continuous-time LTI system described by the differential equation:

$$a_3\frac{d^3y(t)}{dt^3} + a_2\frac{d^2y(t)}{dt^2} + a_1\frac{dy(t)}{dt} + a_0y(t) = b_0x(t)$$

First, we define coefficient matrices:

A=[a3 a2 a1 a0]

B=[b3 b2 b1 b0]

Second, we use the following function:

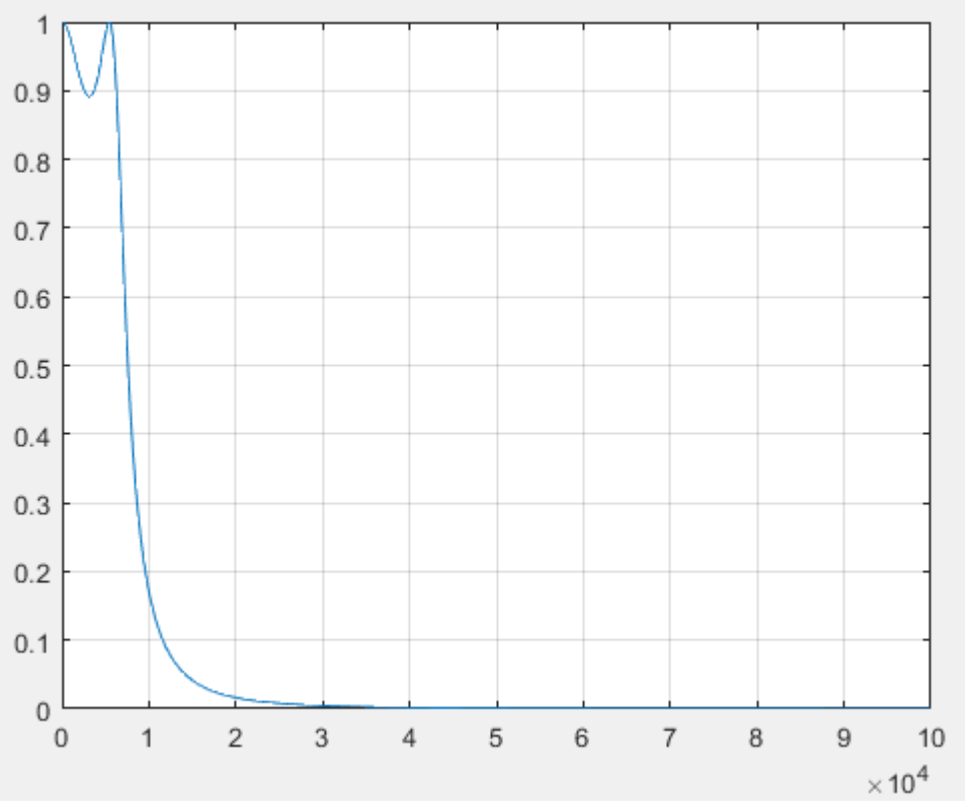
```
[h,w] = freqs(B,A);
plot(w, abs(h))
```

Question 3 – assignment 7:

$$a_3\frac{d^3y(t)}{dt^3} + a_2\frac{d^2y(t)}{dt^2} + a_1\frac{dy(t)}{dt} + a_0y(t) = b_0x(t)$$

a0 = 121868727358.1180, a1 = 48890434.5196
a2 = 6209.9310, a3 = 1, b0 = 121868727358.1180;

```
a0 = 121868727358.1180;
a1 = 48890434.5196;
a2 = 6209.9310;
a3 = 1;
a = [a3 a2 a1 a0];
b0 = 121868727358.1180;
b = [0 0 0 b0];
[h,w] = freqs(b,a);
plot(w,abs(h)); grid on;
```



Thank you!

Now, you do the assignments and send the code to msade033@uottawa.ca

Question 1: Use matlab to find the Fourier transform, $X(j\omega)$, of

- $x(t) = \sin(5t), \ -10 \leq t \leq 10.$
- $x(t) = \frac{\sin(5t)}{\pi t}, \ -10 \leq t \leq 10$

Question 2: Let $x_1(1) = \sin(5t)$ and $x_2(t) = \sin(7t)$, $-10 \leq t \leq 10$, Use matlab to find the Fourier transform, $X(j\omega)$, of $x(t)$ for

- $x(t) = x_1(t/2)$.
- $x(t) = x_1(t) + x_2(t)$.
- $x(t) = x_1(t) \cdot x_2(t)$.

Compare your results with what you expect.

A. Frequency Response of a System

A.1. Given the LTI system:

$$a_2\frac{d^2y(t)}{dt^2} + a_1\frac{dy(t)}{dt} + a_0y(t) = b_0x(t)$$

with $a_2 = 1, a_1 = 12, a_0 = 35$ and $b_0 = 30$. Find (analytically) the frequency response $H(j\omega)$.

A.2. For the frequency values $w = 0 : 0.1 : 100$, plot the amplitude $|H(j\omega)|$ and the phase $\angle H(j\omega)$ of the frequency response $H(j\omega)$ on the same figure.

A.3. Use the function `[h,w]=freqs(b,a)` from matlab to find the frequency response $H(j\omega)$. Plot the amplitude $|H(j\omega)|$ and phase $\angle H(j\omega)$ of the frequency response $H(j\omega)$ in the same frequency interval ω as in part 2. Compare your results with the ones you obtained in section 2.