

MATLAB SESSION

Eng. Rafah Rahhal



STUDENTS-HUB.com

Outline

- MATLAB environment.
- Signals plotting.
- Functions types in MATLAB.
- Plotting functions in MATLAB.
- Solving differential equations.
- Convolution of signals.
- System modeling and simulation.
- Step response & semi log scale functions.
- Spectrum Plotting.
- Laplace and Inverse Laplace. STUDENTS-HUB.com

MATLAB Environment

| Curr | ent Folder | Command Window | Workspace | | |
|------|------------|---|-----------|-------|--|
| | Name 🔺 | | 1 | | |
| ÷ | appdata | New to MAILAB? See resources for <u>Getting Started</u> . | Name 🔺 | Value | |
| ÷ | bin | <i>L</i> | | | |
| ÷ | etc | JX, >> | | | |
| ÷ | examples | | | | |
| ÷ | extern | | | | |
| ÷ | help | | | | |
| ÷ | java | | | | |
| ± | lib | | | | |
| ± | licenses | | | | |
| Đ | mcr | | | | |
| ÷ | notebook | | | | |
| ÷ | polyspace | | | | |
| ÷ | remote | | | | |
| ÷ | resources | | | | |
| | rtw | | | | |

Current folder: To access the project folders and files.

Command Window: The main area where commands entered, it indicated by the command prompt >>.

Workspace: Shows all the variables created and/or imported from files.

MATLAB Environment



Scripts: script files are program files with .m extension. In these files, you write series of commands, which you want to execute together. Scripts do not accept inputs and do not return any outputs. They operate on data in the workspace.

STUDENTS-HUB.com

Run

RUN: After creating and saving the file, you can run it in two ways: Clicking the Run button on the editor window or Just typing the filename (without extension) in the command prompt: >> prog1

• Example(1):

If we have signal $x(t) = \frac{\sin(t)}{2}$, plot x(t) at $t=[0\ 10]$, and label axises.

الخطوات:

١ - تعريف الفترة الزمنية المراد الرسم فيها.

۲-تعريف ال signal المراد رسمها.

۳- رسم x بالنسبة للفترة الزمنية t مع مراعاة الترتيب عند الرسم باستخدام function plot.

x-axis ال Plot(t,x) هو t، ال Plot(t,x)

Plot(t,x,'r') يعني رسم x باللون الأحمر.

Plot(t,x,'r','--') يعني رسم x باللون الأحمر ب خط متقطع.

٣- وضع عنوان للرسم، بالإضافة الى تسمية المحاور.

y تستخدم لوضع عنوان للرسمة، xlabel تستخدم لتسمية المحور x، ylabel تستخدم لتسمية المحور y. Uploaded By: Malak Obaid

STUDENTS-HUB.com

Signals plotting Command Window



If we have signal $x(t) = \sin(t)/2$, plot x(t) at $t=[0\ 10]$, and label axises.



- >> t=0:0.01:10;
- >> x=sin(t)/2;
- >> subplot(3,1,1)
- >> plot(t,x,'r')
- >> title('Signal x(t)');
- >> xlabel('Time');
- >> ylabel('x(t)');
- >> subplot(3,1,2)
- >> plot(t,x,'g')
- >> subplot(3,1,3)
- >> plot(t,x,'*')

STUDENTS-HUB.com

Signals plotting Using script

• Example(1):

If we have signal $x(t) = \sin(t)/2$, plot x(t) at $t=[0\ 10]$, and label axises.



| | | X=sin(t)/2 |
|---|--------|------------|
| Command Window | 0.5 | |
| New to MATLAB? See resources for Getting Started | 0.3 | |
| Hen to minipubli see resources for <u>octaing stated.</u> | 0.2 | |
| N. Gignal platting | 0.1 | |
| >> Signal_protting | 0 X(t) | |
| fx >> | -0.1 | - \ - |
| | -0.2 | |
| | -0.3 | , |
| | -0.4 | |
| | -0.5 | |
| Command window | | Time |
| To call the script code. | | Result |

STUDENTS-HUB.com

<u>Unit step function u(t)</u>: the value of which is zero for negative arguments and one for positive arguments, it is also called "Heaviside function".

In MATLAB we use Heaviside for the unit step function.

Ramp step function r(t):

In MATLAB we use Heaviside for the ramp step function, eg. Heaviside(t)*(t).

Rectangular function pi(t): is called rectangular function or pi function.

In MATLAB we use rectangularPulse.

STUDENTS-HUB.com

plot:

plot(X,Y) creates a 2-D line plot of the data in Y versus the corresponding values in X.

ezplot:

 $ezplot(\underline{f})$ plots the curve defined by the function y = f(x) over the default interval [a b] for x.

New to MATLAB? See resources for Getting Started.

ezplot automatically adds a title and axis labels to the plot.

Command Window

 $f_{\underline{x}} >>$

>> Signal plotting

Example:

STUDENTS-HUB.com

• According to determine a number of samples per second (fs) and number of samples(n).

Example:

STUDF

Create signal(x) which is the sum of three sine signals of requencies 100, 250 and 400 Hz, with amplitudes of 1,2 and 3 respectively.

The samples per second is 5000 and the number of samples is 1000.

>> fs=5000; >> n=1000; >> t=0:1/fs:n/fs; >> x1=1*sin(2*pi*100*t); >> x2=2*sin(2*pi*250*t); >> x3=3*sin(2*pi*400*t); >> x=x1+x2+x3; >> plot(t,x) >> title('X(t)'); >> xlabel('Time'); >> ylabel('X'); >> plot(t,x) >> title('X(t)'); xlabel('Time'); ylabel('X');

- يكون الحل بطريقتين:
 <u>الطريقة الأولى:</u>

 \Box Create the symbolic function y(t) by using "syms".

 \Box Define the equation using" ==", and define the differential using "diff".

Define the initial condition such as "condition=y(0)==3"

□Solve the equation using"dsolve".

Example:

• 10 dy(t)/dt + 20y(t) = 10

| 📝 Edit | or - C:\Users\SAQERpc\Documents\MATLAB\Diff_sol1.r |
|--------|--|
| ∏ Sig | gnal_plotting.m 🛛 Diff_sol1.m 🗶 🕂 |
| 1 - | syms y(t) |
| 2 - | D2 <mark>=</mark> diff(y) |
| 3 - | D3=y(0)==0; |
| 4 - | x=(10*D2)+(20*y)==10; |
| 5 - | dsolve(x,D3) |
| 6 | |

| C | Command Window | | |
|---|---|--|--|
| N | New to MATLAB? See resources for Getting Started. | | |
| | >> Diff_soll | | |
| | D2(t) = | | |
| | diff(y(t), t) | | |
| | | | |
| | ans = | | |
| | $1/2 - \exp(-2*t)/2$ | | |

STUDENTS-HUB.com

الطريقة الأولى:

- یکون الحل بطریقتین:
 - ا الطريقة الثانية:

Give your function a name.

□Use "dsolve(' your equation', 'initial conditions')

Example:

Y=dsolve('3Dy+2y=5', 'y(0)=0')

الطريقة الثانية:

| 1 | 📝 Editor - C:\Users\SAQERpc\Documents\MATLAB\Diff_dol2.m | | | | |
|---|--|-----------------|-----------------|---|--|
| - | Signal_plotting.m 🛛 🛛 | Diff_sol1.m 🛛 🛛 | Diff_dol2.m 🛛 🕅 | + | |
| 1 | - y <mark>=</mark> dsolve('(1 | 0*Dy)+(20*y) | =10','Y(0)=0' |) | |
| 2 | | | | | |
| | | | | | |

| Command Window | | | | |
|----------------|---|--|--|--|
| N | New to MATLAB? See resources for <u>Getting Start</u> | | | |
| | >> Diff_dol2 | | | |
| | у = | | | |
| | $1/2 - \exp(-2*t)/2$ | | | |

STUDENTS-HUB.com

Convolution of signals

Combining two signals form a third signal.

It done by:

STUDENTS-HUB.com

- Define the first signal.
- Define the second signal.
- Use "conv" to convolute first and second signals.

Convolution of signals

| 2 | Ed | itor - C:\Users\SAQERpc\Documents\MATLAB\Conv.m |
|----|----|---|
| 5 | C | Conv.m 🛛 Diff_dol2.m 🗶 🕂 |
| 1 | - | t=0:0.0005:0.05; |
| 2 | - | <pre>x=4*square(500*t,50);</pre> |
| 3 | - | subplot(3,1,1) |
| 4 | - | plot(t,x,'r') |
| 5 | - | <pre>x1=400*exp(-500*t);</pre> |
| 6 | - | subplot(3,1,2) |
| 7 | - | <pre>plot(t,xl,'g')</pre> |
| 8 | - | t1=0:0.0005:0.1; |
| 9 | - | x2=conv(x,x1)*0.0005; |
| 10 | - | subplot(3,1,3) |
| 11 | - | plot(t1,x2) |

STUDENTS-HUB.com

System Modeling and Simulation

$$\frac{dny(t)}{dtn} + \sum_{i=0}^{n-1} (ai \frac{diy(t)}{dti} = \sum_{i=0}^{n} (bi \frac{dix(t)}{dti})$$

1- بنعمل على جعل معامل أكبر قوة بال output يساوي1.

. input عن ال output 2

3- حل المشتقة بال s-domain هو عبارة عن تكامل المشتقة، لذلك بنستخدم بلوك integrator.

4- حل المشتقة بال time domain بنستخدم بلوك التكامل.

STUDENTS-HUB.com

System Modeling and Simulation

 $d2y(t)/dt^2 + 2dy/dt + 4y(t) = 5 x(t)$ Simulation in S-domain:

STUDENTS-HUB.com

Step response & semi log scale functions

To plot the step response in matlab we use command **step.**

Ex : step(sys,t)

To plot the frequency response in matlab we use command **bode**.

STUDENTS-HUB.com

To find the fourrier transform we use command **fourier(y)**.

To plot the spectrum you need to define a suitable number of samples and the sample rate (fs, n).

Apply Fast Fourier transform by using command fft(y).

Then plot the signal in spectral representation using command **plot**.

To compute the laplace transform you should define the function, then use command Laplace (function).

To compute the inverse laplace transform you should define the function, then use command **ilaplace (function)**.

Eng. Rafah Rahhal

STUDENTS-HUB.com