



**The Abdus Salam  
International Centre for Theoretical Physics**



1953-11

## **International Workshop on the Frontiers of Modern Plasma Physics**

*14 - 25 July 2008*

**Numerical Methods and Simulations; Introduction to Matlab.**

B. Eliasson  
*Ruhr Universitaet Bochum  
Germany*

Summer College on Plasma Physics  
ICTP  
Trieste, Italy  
30 July – 24 August 2007

Course: **Numerical methods and simulations**

Tutor: Bengt Eliasson  
E-mail: [bengt@tp4.rub.de](mailto:bengt@tp4.rub.de)  
Internet address: [www.tp4.rub.de/~bengt](http://www.tp4.rub.de/~bengt)

Lecture 1: Introduction to Matlab

Goal of the course:

- Learn basic numerical methods in physics
  - Learn numerical software Matlab
  - Simulations of ordinary differential equations
  - Solution of nonlinear equations and systems of equations
  - Simulations of partial differential equations (if time permits)

In Linux, first open a Console (Terminal).

Matlab is started with the command

```
matlab (press Enter)
```

The basic data in Matlab is *matrices*. Example: The command

```
a=[1 3 2]
```

creates a  $1 \times 3$  row matrix. The command

```
a=[1;3;2]
```

or

```
a=[1 3 2]'
```

creates a  $3 \times 1$  column matrix. The apostrophe (') transposes matrices.

Assignment without output to screen: Use semi-colon after command. Example:

```
c=[2 4 3 5];    (no output to screen)
c              (writes "c=2 4 3 5")
```

Basic operations on matrices:

Add two matrices. Example

```
a=[1 3 2 4]
b=[1 1 1 1]
c=a+b
```

gives the output "c=2 4 3 5"

Element-wise multiplication:

```
a=[1 3 2 4]
b=[3 2 1 1]
c=a.*b
```

gives the output "c=3 6 2 4"

Element-wise division:

```
c=a./b
```

gives the output "c=0.3333 1.5 2 4"

Element-wise power:

```
c=a.^2
```

gives the output "c=1 9 4 16"

Colon notation: practical way to make x-vectors.

```
x=(0:3)
```

gives the output "x=0 1 2 3"

```
x=(0:100)*0.1 (gives "x=0 0.1 0.2 ...9.9 10")
```

Plot a figure:

```
plot(x,sin(x))
```

Label the x-axis:

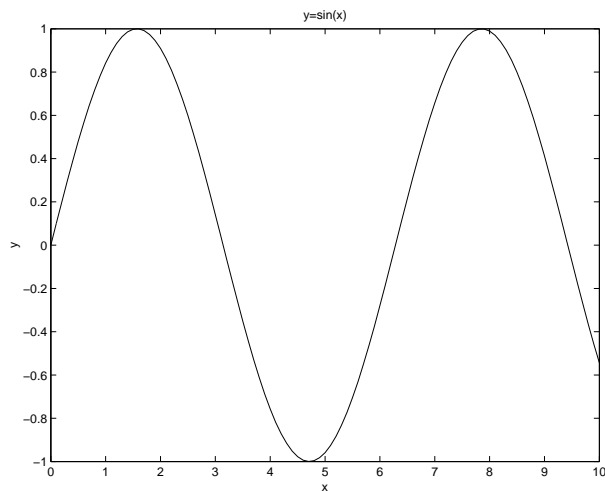
```
xlabel('x')
```

Label the y-axis:

```
ylabel('y')
```

Make a title:

```
title('y=sin(x)')
```



Make a figure file:

```
print -deps fig1.eps
```

(for color figure type: `print -depsc fig1.eps`)

In Linux, you can view the figure file with the command:

```
gv fig1.eps
```

For help on in Matlab, type `help command`, for example

```
help print
```

```
help abs
```

```
help sin
```

Use the command

```
helpdesk
```

to browse commands.

Create your first program in Matlab, choose from the menu

*File / New / M-file*

Inside the file, write

```
disp('Hello world!');
```

then choose *File / Save As* and Filename: `hello.m`

If you now in Matlab type

```
hello
```

then the text `Hello world!` will appear

To modify the "hello.m" program, choose *File / Open* from the menu, then click on `hello.m` and chose `Open`.