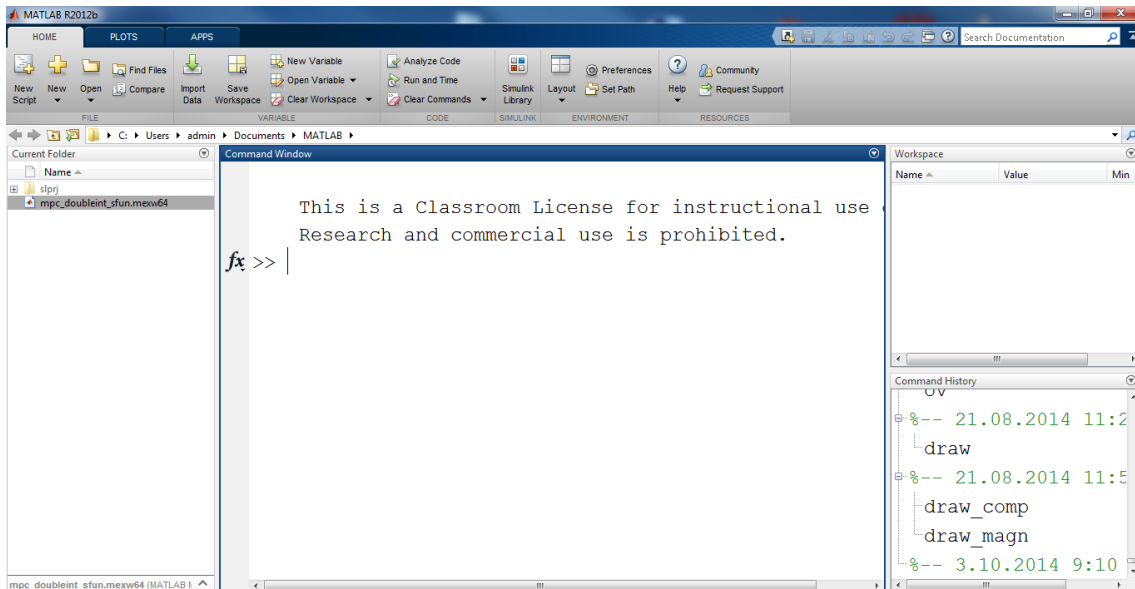


ISS0031 Modeling and Identification

Practice in MATLAB

General overview



Remark 1. If any part of the main window is missing, it is possible to find and recover it from the toolbar menu **Layout**: Command Window, Command History, Current Folder, Workspace, etc.

Remark 2. If you forget the name of a command, you can use either **Product Help** in the toolbar menu or type **help** command name in command window.

Remark 3. If you want to change style (font, font size, etc.), it is achievable via Preferences.

Basic operations in MATLAB

```
>> a = 1 % some comment
```

```
a =  
    1
```

```
>> b = -2; % the semicolon symbol (;)
```

```
>> b^2 % ^ - power symbol; EN: Shift + 6
```

```
ans =  
     4
```

```
>> ab = a + b % sum of a and b
```

```
ab =  
    -1
```

```

>> 1 + 2*sqrt(ab) % square root
ans =
    1.0000 + 2.0000i

>> log(0) % Inf = infinity
ans =
    -Inf

>> var1 = 3.1415e+3 % 3.1415e+3 is the same as 3.1415*10^3
var1 =
    3.1415e+003

```

```
clear all % removes all variables from your base workspace
```

Vectors and matrices

```

>> a = [1 2 3 4 3 2 1] % row vector
a =
    1 2 3 4 3 2 1

>> b = a + 3 % element wise addition
b =
    4 5 6 7 6 5 4

>> A = [9 2 3; -1 3 4; 0 2 1] % symbol ; separates rows of the matrix
A =
     9     2     3
    -1     3     4
     0     2     1

>> At = A' % symbol ' denotes the transpose of the matrix
At =
     9    -1     0
     2     3     2
     3     4     1

>> B = A*At % symbol (*) denotes multiplication of matrices
B =
    94     9     7
     9    26    10
     7    10     5

>> A % displays the content of the variable
A =
     9     2     3
    -1     3     4
     0     2     1

>> A(1,1) + A(2,3) % A(i,j) - ith row and jth column

```

```

ans =
    13

>> A(3,3) = 4 % replacement
A =
     9     2     3
    -1     3     4
     0     2     4

>> row1 = 2:5 % create array with step equals to 1
row1 =
     2     3     4     5

>> row2 = 6:-0.5:3.5 % array with step equals to 0.5
row2 =
     6.0000     5.5000     5.0000     4.5000     4.0000     3.5000

>> A(2:3,1:2) % from 2nd to 3rd row; from 1st to 2nd column
ans =
    -1     3
     0     2

>> inv(A) % returns the inverse of the square matrix A
ans =
     0.1053    -0.0526    -0.0263
     0.1053     0.9474    -1.0263
    -0.0526    -0.4737     0.7632

>> diag(A) % returns the main diagonal of A
ans =
     9
     3
     4

>> eig(A) % returns a vector of the eigenvalues of matrix A
ans =
     0.6426
     7.6787 + 0.4106i
     7.6787 - 0.4106i

>> p1 = poly(A) % returns characteristic polynomial of matrix A
p1 =
     1.0000    -16.0000     69.0000    -38.0000

>> roots(p1) % returns roots of the polynomial p1
ans =
     7.6787 + 0.4106i
     7.6787 - 0.4106i
     0.6426

```

```
>> p2 = [1 -2 0 5]; % row vector contains the coefficients
% of a polynomial, ordered in descending powers, i.e.
% p2 = x^3 - 2x^2 + 5

>> conv(p1,p2) % polynomial multiplication
ans =
    Columns 1 through 7
    1.0000 -20.0000 126.0000 -192.0000 -491.0000 956.0000 -380.0000
    Column 8
    0
```

Anonymous functions

```
>> myfun = @(x1,x2) sin(x1)+2*x2 % defines anonymous function 'myfun'
myfun =
@(x1,x2) sin(x1)+2*x2

>> myfun(1,2) % get function value at coordinates (1, 2)
ans =
4.8415
```

Exercises

Solve the exercises from the lecture using MATLAB.

1. Solve the equation

$$f(x) = 7x^4 + 3x^3 + 2x^2 + 9x + 4 = 0.$$

using one dimensional Newton's method.

2. Solve the system of equations

$$\begin{aligned} F_1(x_1, x_2) &= \sin x_1 + x_2^2 = 0 \\ F_2(x_1, x_2) &= 3x_1 + 5x_2^2 = 0. \end{aligned}$$

using multi dimensional Newton's method.

3. Find the closest line to the points $(0, 6)$, $(1, 0)$, and $(2, 0)$ using the linear least squares approach.

Additional Exercises

Complete the following exercises in the MATLAB environment.

1. Solve the problem

$$f(x) = x^3 - 5x^2 - 12x + 19 = 0.$$

Use several initial guesses to locate all three solutions.

2. Solve the problem

$$\begin{cases} f_1(x_1, x_2) = x_1^2 + x_2^2 - 1 & = 0 \\ f_2(x_1, x_2) = 5x_1^2 - x_2 - 2 & = 0. \end{cases}$$

There are four solutions in total. Can you find them all by choosing different initial estimates?

3. Find the parabola $y(t) = \alpha t^2 + \beta t + \gamma$ that comes closest to the values $b = (0, 0, 1, 0, 0)$ at times $t = -2, -1, 0, 1, 2$.