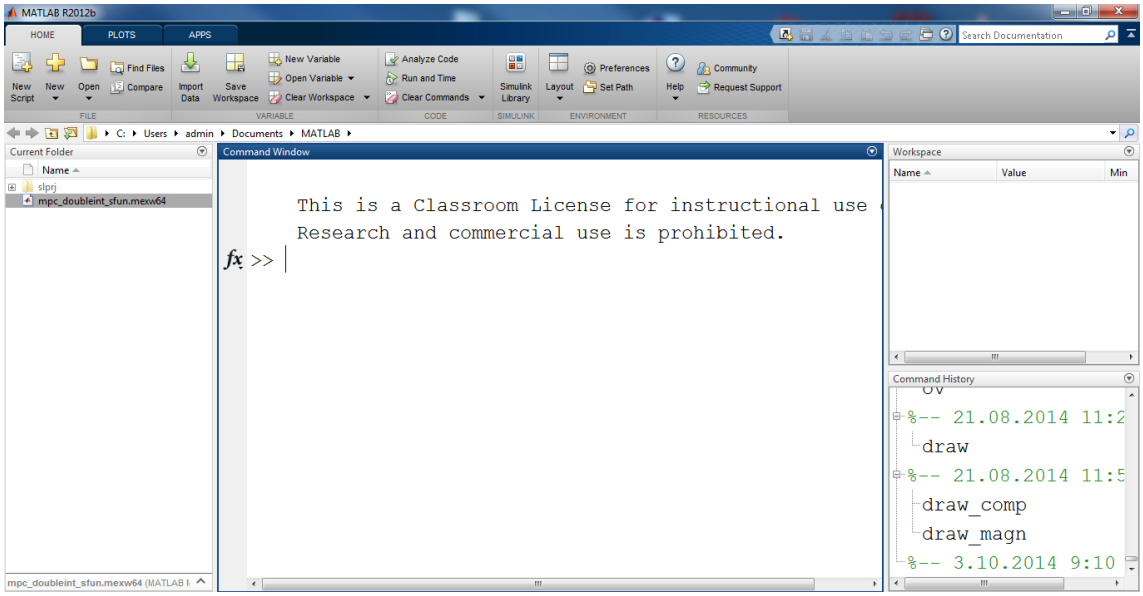
ISS0031 Modeling and Identification

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 $t = -2, -1, 0, 1, 2$.