

Matlab refresher for ODEs

1 General Matlab commands

See “Worksheet 1” of “MS125E Experimental Maths”.

- Defining the function $f(x) = \sin(x^2)$:
`f = inline('sin(x.^2)', 'x')`
- Plotting the function $f(x)$ with x between -3 and 3 :
`ezplot(f, [-3,3])`
- Defining y to be the symbolic expression $\sin(x) - x^2$ with x as a symbolic variable:
`syms x`
`y=sin(x)-x.^2`
- Making the symbolic expression into a function f_1 , i.e., define the function $f_1(x) = \sin(x) - x^2$:
`f1=inline(char(y))`
- Differentiate the symbolic expression y with respect to the symbolic variable x (x is not cleared, so still a symbolic variable):
`diff(y,x)`
- Differentiate the symbolic expression $t \sin(t)$ with respect to the variable t :
`diff('t*sin(t)', 't')`
- Integrate the symbolic expression y with respect to the symbolic variable x :
`int(y,x)`
- Integrate the symbolic expression $t \sin(t)$ with respect to the variable t :
`int('t*sin(t)', 't')`
- The 2×2 matrix $A = \begin{pmatrix} 2 & 4 \\ -3 & 5 \end{pmatrix}$ is defined by
`A=[2,4; -3,-5]`
- To make A into a symbolic matrix, use
`A = sym(A)`
- The eigenvalues of the matrix A are found via (the result is a vector with the eigenvalues of A)
`eig(A)`
- The eigenvalues and eigenvectors of the matrix A are found via (the i -th columns of V is the eigenvectors with the eigenvalue on the i -th diagonal position of D)
`[V,D] = eig(A)`

The output of Matlab for the previous command (figure for ezplot is on the next page):

```

Command Window
New to MATLAB? Watch this Video, see Demos, ...

>> f = inline('sin(x.^2)','x')

f =

    Inline function:
    f(x) = sin(x.^2)

>> ezplot(f, [-3,3])
>> syms x
>> y=sin(x)-x.^2

y =

sin(x)-x^2

>> f1=inline(char(y))

f1 =

    Inline function:
    f1(x) = sin(x)-x^2

>> diff(y,x)

ans =

cos(x)-2*x

>> diff('t*sin(t)','t')

ans =

sin(t)+t*cos(t)

>> int(y,x)

ans =

-cos(x)-1/3*x^3

>> int('t*sin(t)','t')

ans =

sin(t)-t*cos(t)

```

```

Command Window
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>>
>> A=[2,4; -3,-5]

A =

     2     4
    -3    -5

>> eig(A)

ans =

    -1
    -2

>> [V,D] = eig(A)

V =

    0.8000   -0.7071
   -0.6000    0.7071

D =

    -1     0
     0    -2

>> A=sym(A)

A =

 [ 2, 4]
 [-3, -5]

>> [V,D] = eig(A)

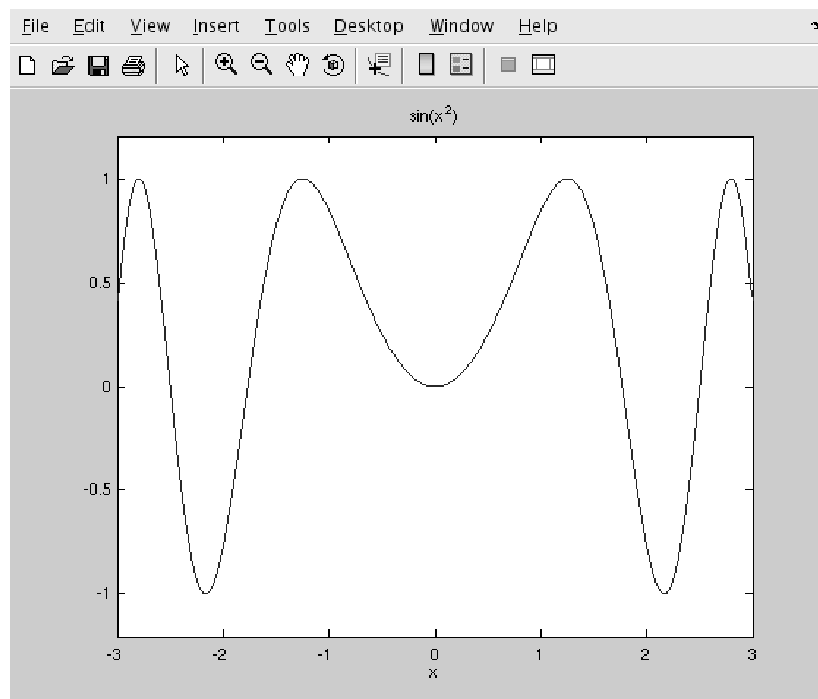
V =

 [ -4/3,  -1]
 [  1,    1]

D =

 [ -1,  0]
 [  0, -2]

```



2 Matlab commands for ODEs

See “Worksheets 6 and 7” of “MS125E Experimental Maths”.

- Symbolic solving of the ODE $\frac{dy}{dx} = 3y$ with $y(x_0) = y_0$ is done by `dsolve('Dy=3*y', 'y(x0)=y0', 'x')`
- Symbolic solving of the ODE $\frac{dy}{dx} = 3x$ with $y(x_0) = y_0$ is done by `dsolve('Dy=3*x', 'y(x0)=y0', 'x')`
- The matlab toolbox for plotting direction field of scalar ODE is `dfield7`
- The matlab toolbox for plotting phaseportrait of 2×2 system is `pplane7`