Assignment 6: Basic Matlab Operations

Date Due: March 25, 2015   Instructor: Trani

Problem 1

Use Matlab to solve this problem.

a) Create a new Matlab script and define two vectors representing the time and horizontal movement experienced by a building during an earthquake:

time=0:.1:25;

x=time.^1.85.*exp(-time).*(1-cos(time/8));

where:

time = time in seconds

x=horizontal displacement of the building in meters

In your script make a simple plot using the "plot" function in Matlab. Label the x-axis as 'Time (seconds)' and the y axis as 'Displacement (meters)'. Add a grid to the plot using the 'grid' attribute of the plot.

b) Modify the script created in part (a) and using the interactive 'Tools-Edit Plot' adjust the color of the line to be dark red and the line width to be 2.5. Use "circle" markers in the modified plot.

c) Modify the script created in part (a) creating another variable z.

$z = gradient(y)$ % the Matlab function gradient takes the first derivative of the values of vector (x)

Using the "subplot" command create a new figure with two plots. Plot the values of time vs. x in the upper part of the window and time vs. z in the lower part of the same window. Change the line colors to distinguish the two views.

d) Verify that the "gradient" function is working. Verify a few numbers by hand if necessary.

Problem 2

Use Matlab to solve this problem. Use the the Autobahn data file provided in the Syllabus page (week 1 - practice files).

   a) Create a Matlab file and paste all the Autobahn data into. Save the file with any name of your choice.

   b) Crete a Matlab script and read the data using the Import the Autobahn data using the "load" command.

   c) Create variables for each column of data provided. Label the variables Speed and Density.

   d) Plot the traffic density vs. speed using a standard x-y plot. Density is the independent variable and speed the dependent variable in your plot.

   e) Perform a simple linear regression analysis using the Basic Fitting tools available in the plot window (under tools). State the linear equation that represents the best fit to the data.

   f) Looking at the plot and your regression equation, estimate the traffic speed when 50 vehicles per kilometer are detected on the road by a real-time surveillance camera.

Problem 3

Use the GPS data collected in Arizona to do this problem. A sample of the data is shown below.

% GPS car data collected in rural roads in Arizona

% Car = Toyota Corolla (1992)

% Column 1 = Time of observation (seconds)

% Column 2 = Distance traveled (m)

% Column 3 = Speed (km/hr)

0	0	0
2	23	41.4
4	52	52.1
6	82.9	55.6
8	115.6	58.9

Create a Matlab script that performs the following steps:

a) Import the data into Matlab using the "load" command.

b) Plot the speed of the car (in y-axis) vs. time (x- axis). Observe the plot and comment on the number of stops the vehicle makes.

c) Convert the speed data into units of meters per second. Create a new variable to store the speed values in m/s.

d) Estimate the acceleration of the car as a function of time. Use the Matlab "gradient(x)" function to find the acceleration using the speed vector created in part (c). Plot the calculated acceleration vs. time recorded by the GPS data logger unit.

d) Use the Max(x) command in Matlab to detect the largest speed during the journey. Find the time when the maximum speed is recorded.

e) Find the average speed of the car for the complete profile. Use the Matlab function MEAN(x) to get the average speed.

f) Find the total distance traveled by the car.

g) Find the number of seconds the car is traveling above 30 km/hr. Use the Matlab FIND(x>30) function to do this part.

Problem 4

Use Matlab to solve this problem. Create a new **Matlab script** and define two matrices, A and B as shown below. Use (;) to separate the rows in the matrix and use square parenthesis to define the numerical values inside the matrix.

Perform the following matrix operations. In one line comment on the results obtained after each operation.

$$A = \begin{bmatrix} 2 & 3 & 5 & 7 \\ 2 & 9 & 7 & 5 \\ 6 & 4 & 2 & 1 \\ 3 & 1 & 2 & 6 \end{bmatrix}$$

$B = [10\ 20\ 18\ 14]$

$C = B \times A$

$D = B(1:3)$

$E = 45 * B' + 10$

$F = A(:,3) + 6;$

$G = diag(A)$

$H = diag(A) + B$

$J = zeros(4,4) + 2.5 * A$

$x = inv(A) * B'$