ENGR 253 LAB #2 - MATLAB Functions and Signal Plots

Objective

Understanding of Script-file, function () and other basic MATLAB commands. Application of learning to signal and systems concepts.

Resources

- Signals & Systems textbook by Oppenheim and Willsky
- Windows running MatLab release 14 or later
- USB hard disk or other removable drives (note Lab computer data is lost after reboot)
- Course Lecture Material

Background

1) MatLab Scripts (programs) are written and saved in the M file format (sample.m). Use the "File > New > M-file" menu to start the editor for a new file.

2) Each M-file contains zero or more functions that can be called from the command window by entering the function name and parameters.

   Syntax → function [out1, out2, ...] = funname(in1, in2, ...)

   More information is available on function by using the help search with keyword "function" in the help section. Note that as a default the name of M-file without extension will be used to call the function.

   Below is an example of M-file and function:

```
%{  filename: mySum.m
    File name (excluding extension) is the same as the name of the function
    Adds two numbers and return the sum and the operands in an array
    MATLAB is case sensitive (mySum is not the same as mysum)
%}
function [sumR, OperR1, OperR2] = mySum(Oper1, Oper2)

% Add the two values and assign results to the variable sumR  -- MATLAB does not require variable
declaration
sumR = Oper1 + Oper2;
OperR1 = Oper1 + 1;
OperR2 = Oper2 + 2;

% MATLAB does not require a terminating clause for function and M-file.  But use of the optional "end"
% statement is a good practice.
end

% note a semicolon is not used to terminate statements – end of line terminates statements.
% using Semicolon will prevent the operation output from being displayed.
```

   a) It is recommended that you create a mySum.m M-file and use the command window to run mySum. To run the above function, enter the following in the command window.
      [a, b, c] = mySum(4, 5)

      After this command is executed → a = sumR, b = OperR1 and c = OperR2.

      In order to clear the command window, type "clear" command.

3) Arrays are used for storing data points in MATLAB. For a complete overview of Arrays refer to the "Array Information" in the help section. Here are some basic arrays:

```
A(j : k)                % display array elements from  j to k,
A(1)                    % refers to first element
n = [-3 : 3]            % n = -3, -2 … +2, +3
X = [zeros(1,47), n, zeros(1,47)]       % X will contain values of n in the middle and 0s on both side
X = Ones(2,23)          % Create an array with two rows and 23 columns of 1s
% remember if you terminate the statement with semicolon then it will not print out the results.
X = [1 : 0.1 : 2);      % X= 1, 1.1, …,1.9, 2)
B = [1,2,3;4,5,6;9,8,7]         % Semicolon is used to separate rows in a two dimension array
```

4) You can plot using the command stem (X, Y). This command plots Y versus X. X and Y must be vectors (one dimension array) of same size. For more detail use the help documentation on stem. Here is a usage example:

```
n = [ 0 : 1 : 29];      % Create an array from 0 to 29
X = sin (n*pi/5);       % Evaluate the sin for all values of n
Stem (n, X)             % Plot sin vs. n
```

5) Others
   a) MATLAB will assume that “i” and “j” are both referring to the imaginary number square root of (-1).
   b) Exp(n) is the function used to evaluate e^n.
   c) real(x), imag(x), abs(x) and angle(x) functions should also be considered in completing this lab.

6) Review chapter 1 Material from Signals & Systems text for this lab.

Experiment #1

Write a function that plots u[n-5] for n from -20 to 30. Explain your result's consistency/inconsistency with Step function definition.

Experiment #2

Write a function that accepts values for signal X[n] as an array with $-100 \leq n \leq 100$. The function should plot the signal resulting from multiplication of X[n] and (δ[n-3] + 10δ[n+3]).

Include the use of title('text'), xlabel('text') and ylabel('text') in your program to better annotate your plot.

Experiment #3

Write a function that plots the magnitude, phase, real part and imaginary part of the $e^{-jn\pi/17}$ function from n=0 and for two full periods.

Experiment #4

Identify another command that performs a similar function to Stem() and describe the similarities and differences.

Report Requirements

Reports must be prepared individually even if the experiments are performed as a team. All reports must be computer printed (Formulas and Diagrams may be hand drawn) and at minimum include:

For each Experiment

a) A clear problem statement; specifying items given and to be found.
b) Theory or process used.
c) Resulting circuits, calculation, tables, timing diagram, schematic and other relevant results.

For the report as a whole

a) Cover sheet with your name, class, lab, completion date and team members' names.
b) Lessons Learned from the experiments.
c) A new experiment and expected results which provide additional opportunity to practice the concepts in this lab.