

Assigned: 8/24/11

Due: 8/31/11

Convolution

Getting Started

1. To start MATLAB on a PC, simply go to Start->Programs and start MATLAB from the menu.
2. To become familiar with some of the “gee-whiz” capabilities of MATLAB, try running `echodemo xfourier`. The text shows the MATLAB commands that were used to generate the examples. You may also wish to explore some of the other examples by running `demo` and exploring the options.
3. Run `echodemo intro` to get an idea of the basic capabilities of MATLAB.
4. You can type `doc` at any time to get a hypertext version of the MATLAB Reference Guide or `help <cmd>` to get help on specific commands (assuming this is installed on the machine where you are).
5. If you need help on a MATLAB function and the hyperlink doesn't work, simply type `help <function>` at the MATLAB prompt.

Exercises

1. Write a MATLAB function to generate a sawtooth waveform (rising from an amplitude of 0 to A) of length L samples and period T samples. A sawtooth wave begins at 0 and rises in a straight line to A and then repeats. By learning from the triangular waveform function example in MATLAB for DSP, it is possible to write this function without loops. (This is **not** necessary for full credit.) Include a listing of your function.
2. Create two signals:
 - (a) Create a length-12 vector representing an impulse (`delta1 = [1 zeros(1,11)];`). Note that this is an impulse with some of the zeros shown, not a pulse.
 - (b) Create a wave `s1` with $L = 80$, $A = 2$, and $T = 20$.
3. Use `conv` to convolve `s1` and `delta1`, and plot the result using `stem`.
4. Examine another convolution:
 - (a) Create another vector of length 12 representing an impulse at 0 and 11. (`delta2 = [1 zeros(1,10) 1];`).
 - (b) Convolve `delta2` with `s1` and plot the result.
 - (c) Explain the relationship between this plot and the previous one.
5. Examine another type of impulse response:
 - (a) Create a flat impulse response `hn3` that is three points long and normalized by the length (`hn3 = 1/3*[ones(1,3)];`).
 - (b) Convolve `hn3` with `s1`.
 - (c) Increase the length of the impulse response to 5 and 10 (normalizing by the length) and redo the convolution.

- (d) What happens to the result as the length of the impulse response is increased? Explain.
6. Let $x[n] = \mu[n] - \mu[n - 5]$. Let $h[n] = \delta[n] + 2\delta[n - 3]$. Determine $x[n] * h[n]$ analytically, explaining each step. (Keep $x[n]$ in the form of a difference of two step functions and not a list of numbers. Your answer should be a functional expression, not an explicitly written sequence of numbers.) Check your result using MATLAB. Explain how you checked the result.

Write a **concise** report describing your findings following my format instructions. The report should contain a concise description of your results and all plots you were required to generate. *Be sure to answer all questions.*

NOTE: All out-of-class work is to be done independently. Sharing of programming tips and discussing general concepts is ok. Collaborating on experiments or code-writing is not. Any such collaboration on these assignments will be considered an act of dishonesty and will be treated accordingly.

For further help:

- MATLAB Primer
- MATLAB Help Desk