ELEE4920/5920 MATLAB PROJECT ZERO

An introduction to basic features

Term II
2020-21
January 19 2021

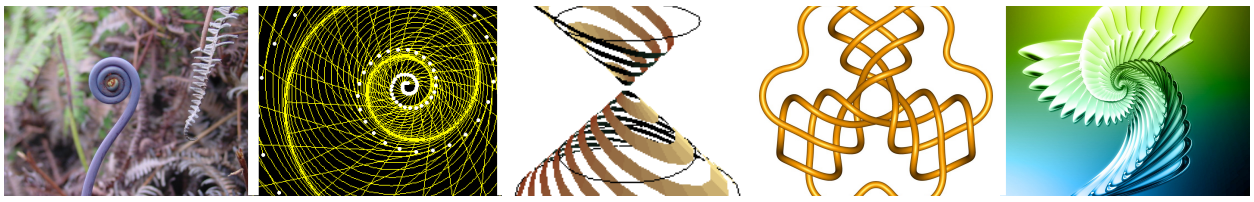
Assignment Date: January 19, 2021
Due Date: January 29, 2021

IMAGE PROCESSING

Introductory Project -- Matlab

Introduction

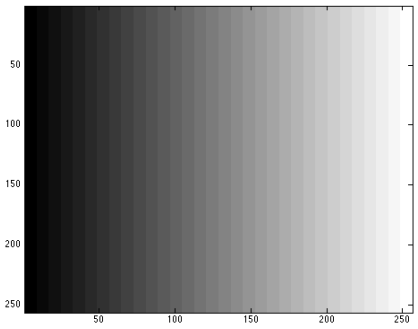
This short project is intended to introduce you to some of the image processing features of the Matlab software package. To undertake this project effectively, you will need to use Matlab and the image processing toolbox.

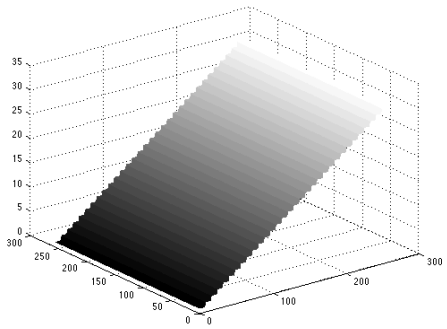


Images Courtesy of Internet Piracy

Part 1

In matlab, generate a 256x256 image which displays a gray scale *step* pattern which progresses from 0 (black) on the left column to 255 (white) on the right in 32 even *steps*. Plot this image in Matlab using the **mesh**, **surf,** and **image** commands (be





sure to generate a hardcopy/pdf printout). Other commands you may find helpful include: **meshgrid**, **colorspace**, **linspace**, and **find** among others.

1. Begin by trying to use some basic matrix manipulations (like inner and outer products) to generate a matrix containing the values. A good way to start is to type **demos** in the command window, select "Documentation Home" at the top of the screen and then select "MATLAB" from the contents on the left. Begin with *Getting Started* and dig into the Desktop Basics, Matrices and Arrays, Programming and Scripts etc. to become familiar with the basics. Next go to the Mathematics (back up from Getting Started) and work through elementary math and linear algebra. If you want to become versant with the use of the Integrated Development Environment, you can select "Desktop Environment". You should notice the options for online learning via the MATLAB Onramp training which appears at the right of the Getting Started page. The goal here is to become somewhat comfortable with the Matlab environment if you have not used it in a while.

2. Next move on the Graphics section to refresh your plotting and display understanding for 2D and 3D data. Next, you can browse the Image Processing and Computer Vision toolboxes.

3. Before you go much further you should go through the various tutorials that are available on the **Desktop Tools and Live Editor** sections (Use the Matlab search bar and search for Live Editor). This will help you learn how to take advantage of the many nice features of the Integrated Development Environment and to create html, word or pdf files for your homework and project submissions. Note there is no longer a "Publish" tab in the editor window. Rather you select pull-down options from the Save Button menu.

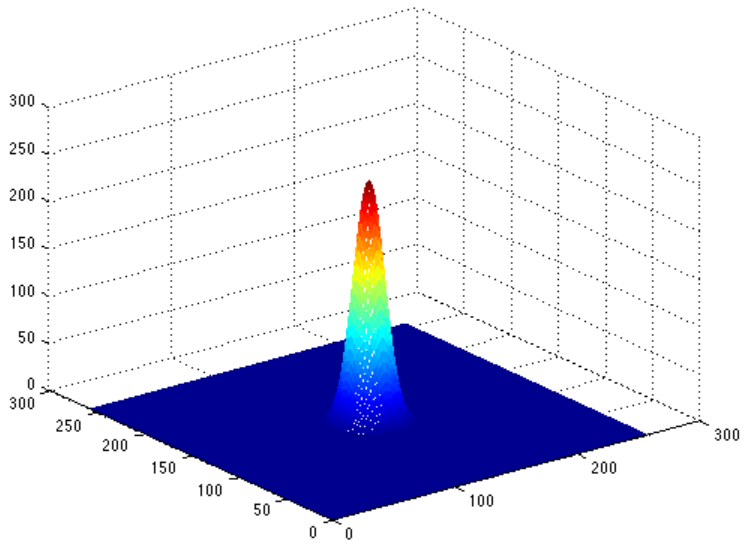
Part 2

In addition to the simple gray scale wedge described above, you are to generate a 2D gaussian distribution which obtains its maximum of 255 in the center of the image (choose a mean = 0, and a standard deviation = 10). A 2D gaussian distribution may be generated via the following equation for independent variables x&y:

Your final solution should be clearly commented. You should use the pdf publishing feature described in the recommended tutorials to generate a folder for submission

$$f_{xy}(x,y) = f_x(x) * f_y(y) = \left(\frac{1}{\sigma_x \sqrt{2\pi}} e^{-\frac{(x-E(x))^2}{2\sigma_x^2}} \right) \left(\frac{1}{\sigma_y \sqrt{2\pi}} e^{-\frac{(y-E(y))^2}{2\sigma_y^2}} \right)$$

of your results (include plots).



1. Consider this preliminary hint, which explains one way to generate the x vector in the exponential equation above. Recall that matlab can take the exponential of an entire vector or matrix at one time.

```
% generate vectors which express: (x - E(x))/2*stdx.
% Notice that even though the problem specifies a zero mean, the prob-
% lem also asks that the distribution obtain its maximum at the center
% of the image frame.  Since the image extends
% from 0-255, we achieve this desired result by offsetting the x and y
% vectors by 127 which effectively shifts the waveform.
x= (([0:255]-127).^2)/(2*(stdx.^2));
```

Course Learning Outcomes Addressed:

1. Demonstrate an understanding of the engineering science which underlies the field of image processing. (ECE 1).

Project Report Format (submit electronically via email):

Reports must be prepared within the Matlab editor using the publishing features as single pdf document published from a single live editor file. You should use proper headings and comments and formatting in your script file. Be sure your name is in the title of the script and in the file name. This file should be uploaded via the Assignment on blackboard. Be

sure to use copious comments and section headings as described in the document suggestions above and on the web

1) https://www.mathworks.com/help/matlab/matlab_prog/create-live-scripts.html),
2) https://www.mathworks.com/help/matlab/matlab_prog/format-live-scripts.html,
3) https://www.mathworks.com/help/matlab/matlab_prog/insert-equations.html,

For those more interested in watching movies, Mathworks also maintains a videos website with many recorded tutorials (https://www.mathworks.com/videos.html). Include the following sections in your script file and published results (include in the live editor file using markup to create headings, bullets, italics and bold face as appropriate):

Section I (cover page)

Student name
Course and project number
Date Due
Date Handed In
Abstract (no more than ½ page)

Section II

Technical discussion (Theory). Describe the method used to generate your results. Here you can use the heading sections and formatting features provided to produce a nice result.

Graduate Students: Use embedded LaTex statements [or as a substitute, the interactive editor features] to reproduce professional equations in your published text.

Section III

Discussion of your solution/results. You may choose to place your image results in between the text portions of this section along with associated code if you prefer.

Section IV (if not included above)

Image results. Each image must contain a figure title/description comment. Any associated code or Program listings (fully commented).

Grading

This project will be collected and a solution will be worked out together in class. The assignment will be graded as Pass/Fail as it is intended to be a Tutorial effort. Please pay spe-

cial attention to the Report generation because the effective use of the editor and the associated publishing tools is a key part of this assignment.