

Assignment A1: Image Representation and Formation

CS 4640
Fall 2021

Assigned: 24 August 2021

Due: 9 September 2021 (Turn in a PDF report and .m files through Canvas; turn in a hardcopy of PDF printout in class)

1. Do Chapters 1 and 2 exercises. You are expected to know this material, and it may be used on quizzes. In the report, state that you did them and describe any complications you ran into.
2. Use the Matlab function *imapprox* to segment Coke bottles in the textbook's Project on inspection of bottles. Propose some performance measure and use it in your evaluation. Report what you tried and what results you got. Use figures to show the results.
3. Matlab provides the *rgb2gray* function to convert from rgb images to gray level. Based on the provided function, *CS4640_show_images*, create a new function *CS4640_show_gray_images*, which displays all the jpg images in a directory as gray level images. Use the following header:

```
function CS4640_show_gray_images(d_name)
% CS4640_show_images - show all images in a directory as gray level
% On input:
%     d_name (string): name of directory path
% On output:
%     N/A (displays images)
% Call:
%     CS4640_show_images('bottle_images');
% Author:
```

```
% <Your name>
% UU
% Fall 2021
%
```

4. Use the trees (RGB version) image to determine the α , β , and γ rgb to gray level coefficients for the Matlab *rgb2gray* function. That is, take the gray level image and make a 90300x1 vector called *b*, and the 90,300 pixels in the rgb image and make a 90300x3 matrix called *A*, and use `coefs = A\b` Matlab command to find the coefficients.

5. Use the perspective project equations to develop a model for the camera used to obtain the bottle image. Describe your work for each of the following steps in detail with drawings; pay particular attention to showing the coordinate systems used, how measure were made in them, and how specific values were obtained. Discuss any problems or discrepancies that posed an issue.

- Get a physical Coke bottle like those in the image,
- use a camera (e.g., your phone) to image the bottle so it appears like in image001.jpg,
- determine an estimate of *Z* (in 3D coordinates),
- use some properties of the bottle (e.g., the width and height of the cap) to determine actual *X* and *Y* locations in the image,
- use Matlab function *impixelinfo* to get the row and column values for some points on the bottle, and
- based on all this, determine the focal length for the camera that took the Coke bottle images.

General Instructions:

Turn in (through Canvas) a report describing the work you did on these problems, as well as the Matlab .m files for the requested functions. Also, submit any helper functions required to run the assigned functions. All functions must have headers conforming to the requested layout.

Matlab Note: DO NOT USE SCRIPTS. No function should write to the interpreter, draw, etc. unless that is its actual function (e.g., *CS4640_show_images*).

Report Format:

The report must have the following:

- Title: Assignment 1.
- : Your Name
- Date
- CS4640
- A labeled section for each problem.
- page numbers
- Each figure must have:
 - Figure number
 - Caption describing figure
 - If a graph, then axes must be labeled.