Lab 4: Intensity Transformation Functions

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02/24/2023

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**OBJECTIVE:** The objective of this lab exercise was to learn and familiarize myself with the different intensity transformation functions available for use in image manipulation. Additionally, hard-programmed methodologies rather than built-in functions were used to allow myself to understand the underlying logic under each of the transformations.

**METHODS:** In part 1, the function imcomplement() was used to get the negative image of the MRI.

In part 2, a graph displaying the 4 gamma functions was created to better understand how the transformations were calculated, each of which are displayed in a single figure.

In part 3, like part 2, a graph displaying 4 logarithmic functions was created, and the four images were displayed in a figure with 2x2 subplots.

In part 4, like part 2 and 3, two graphs displaying 4 contrast stretching transformation functions were created, one for constant m value and one for constant E value, and the four images for each were displayed in two figures with 2x2 subplots.

In part 5, no graphs were created, but the two images that represent the result of intensity slicing were displayed in a figure with 3 subplots.

In lab exercise A, I loaded the bone fracture image with imread() and then converted it to a grayscale image using rgb2gray, which was then converted into a double array using im2double for intensity transformation. For log transformation, I altered the c value a few times to get an outcome that seemed to be the best. For contrast stretching transformation, I altered m and E values simultaneously to get the best outcome.

In lab exercise B, although I was not required, I decided to create two images of intensity slicing, one without background and one with background intensity reduced. I decided on the value for the lower limit prior to the upper limit, just for the ease of manipulation of variables. Once I got the desired outcomes, I plotted each on a single figure with the original image, intensity sliced image without background, and intensity sliced image with background reduced by half.

**RESULTS:** In part 3, the logarithmic transformations section, I initially got a graph that had 5 transformation functions rather than 4. This was happening because I did not clear the variables after the previous part, part 2, which had 5 functions in the variable y rather than 4, which were the designed functions for part 3. Thus, once I added clear; prior to the code in each sections, I was able to resolve this problem.

In part 4, the contrast stretching transformation section, the output images for when m was held constant and only the E value was being manipulated were not the same as seen in the tutorial. The produced images had their intensities much larger than the provided image in the tutorial, which is interesting because the code being used should be the exact same. Since I am unable to see the value of the variables in the tutorial, I was unable to come up with a conclusion for the reason for this difference; however, I believe that this difference is due to the difference in the m value, since the E values are hard-coded. Comparing the tutorial images and the produced image, it can be observed that the m value in the tutorial was much higher than that in my program.

In exercise A, after many trials, I decided that c value should be 1.25 for the log transformation section, and m value of 0.9 and E value of 5 for contrast stretching transformation section. The contrast stretching transformation produced an image that I believe is much easier to see the fracture. This is because the contrast stretching transformation is capable of reducing lower intensity values which enables the amplification of contrast in an image.

In exercise B, after many trials, I decided that the lower limit is 205 and the upper limit is 225. With this, I initially only produced an intensity sliced image without background. However, with the background missing and the intensity slice only displaying the high-intensity high-contrast sections of the fracture, the produced image did not seem very good. Therefore, I decided to produce another image with the same threshold but with background. For this image, I reduced the intensity of the background, since the background intensity of the original image is relatively high, and I wanted to increase the contrast.

**CONCLUSION:** These exercises showed that the utilization of mathematical and logical functions on image manipulation allows the user to visualize important traits with much more ease. Additionally, different transformation functions produce different outcomes with different variables, so it enables the user to manipulate and use different methodologies to get an image that they can see best.

**APPENDIX:**