Part 1 – Detecting Image Contrast Enhancement

Figure 1: imageCE1.tif

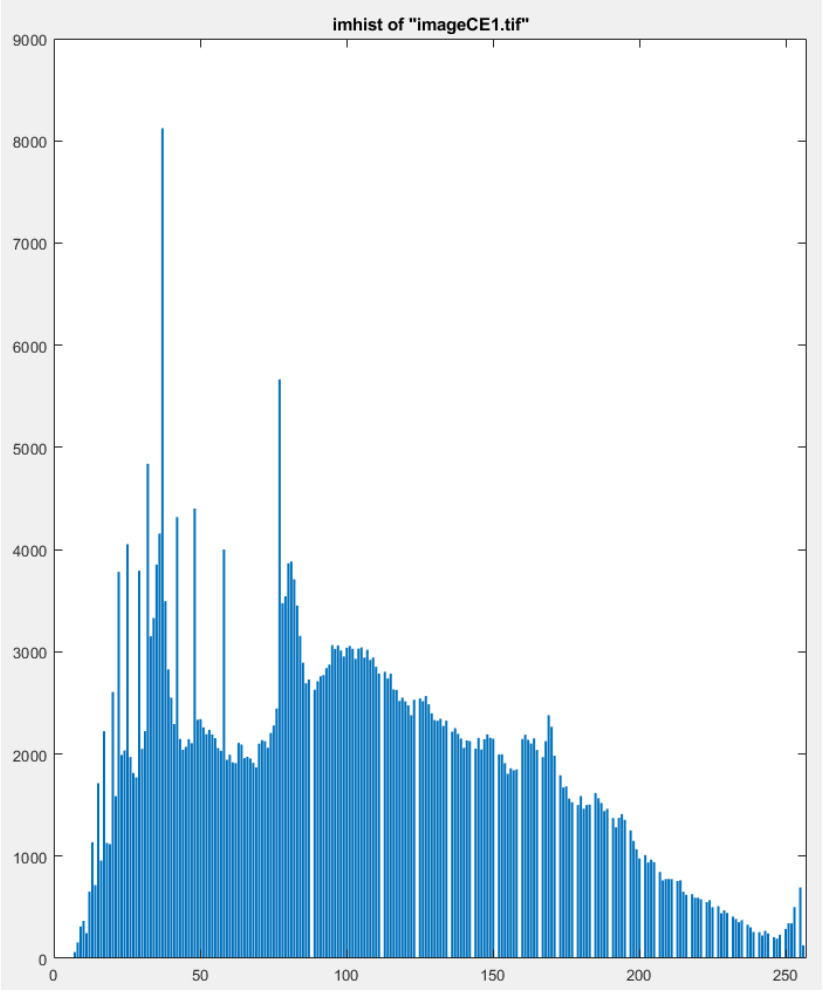

Figure 2: imhist of imageCE1.tif

Figure 3: imageCE2.tif

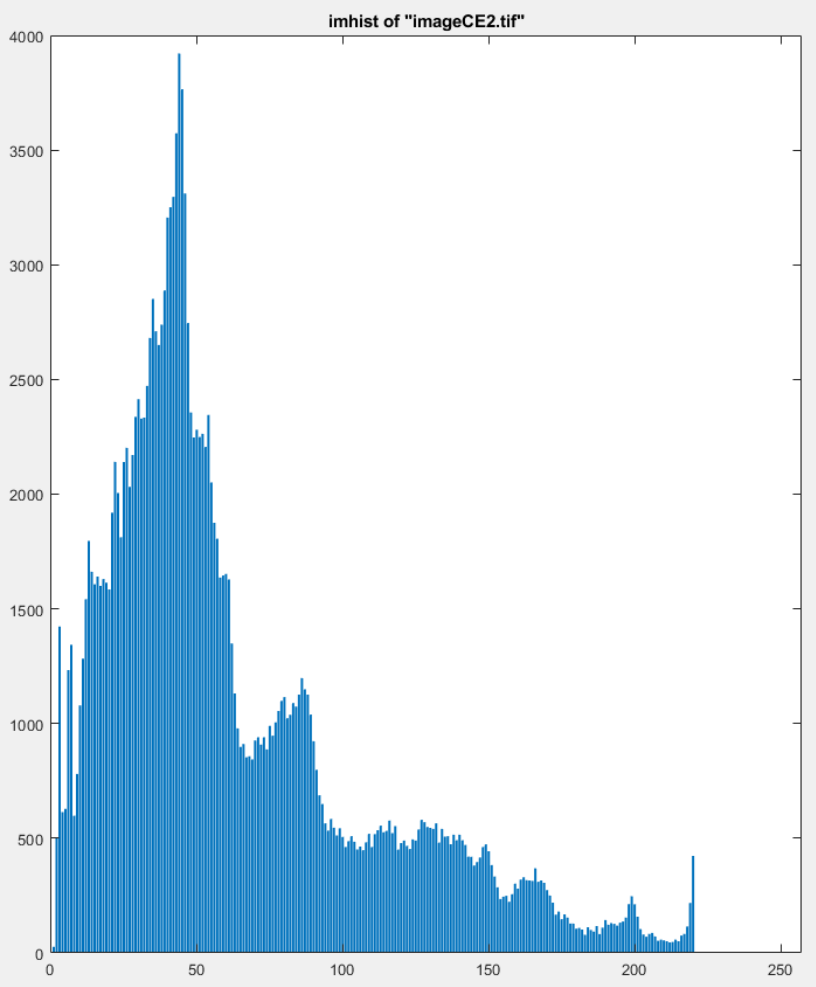

Figure 4: imhist of imageCE2.tif

Figure 5: imageCE3.tif

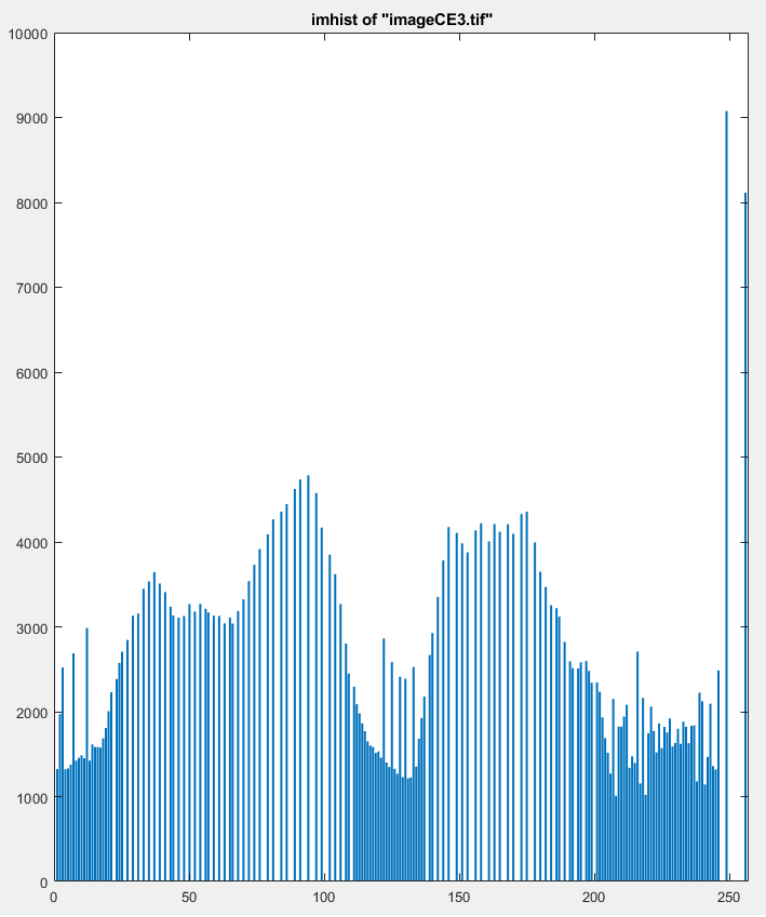

Figure 6: imhist of imageCE3.tif

Figure 7: imageCE4.tif

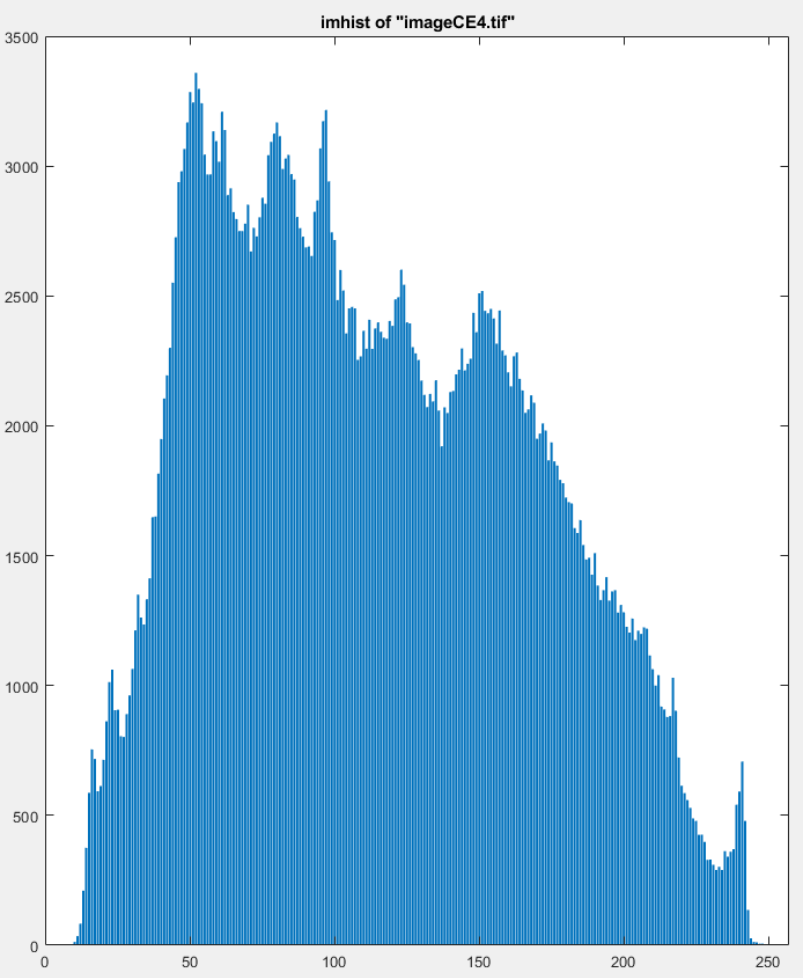

Figure 8: imhist of imageCE4.tif

Based on knowledge of contrast enhancement fingerprints, it appears as though *imageCE1.tif* and *imageCE3.tif* have been contrast enhanced. Both image's pixel value histogram graphs (shown using the Matlab command: *bar(imhist(<image>))*) show gaps and impulsive peaks – indicative of contrast enhancement.

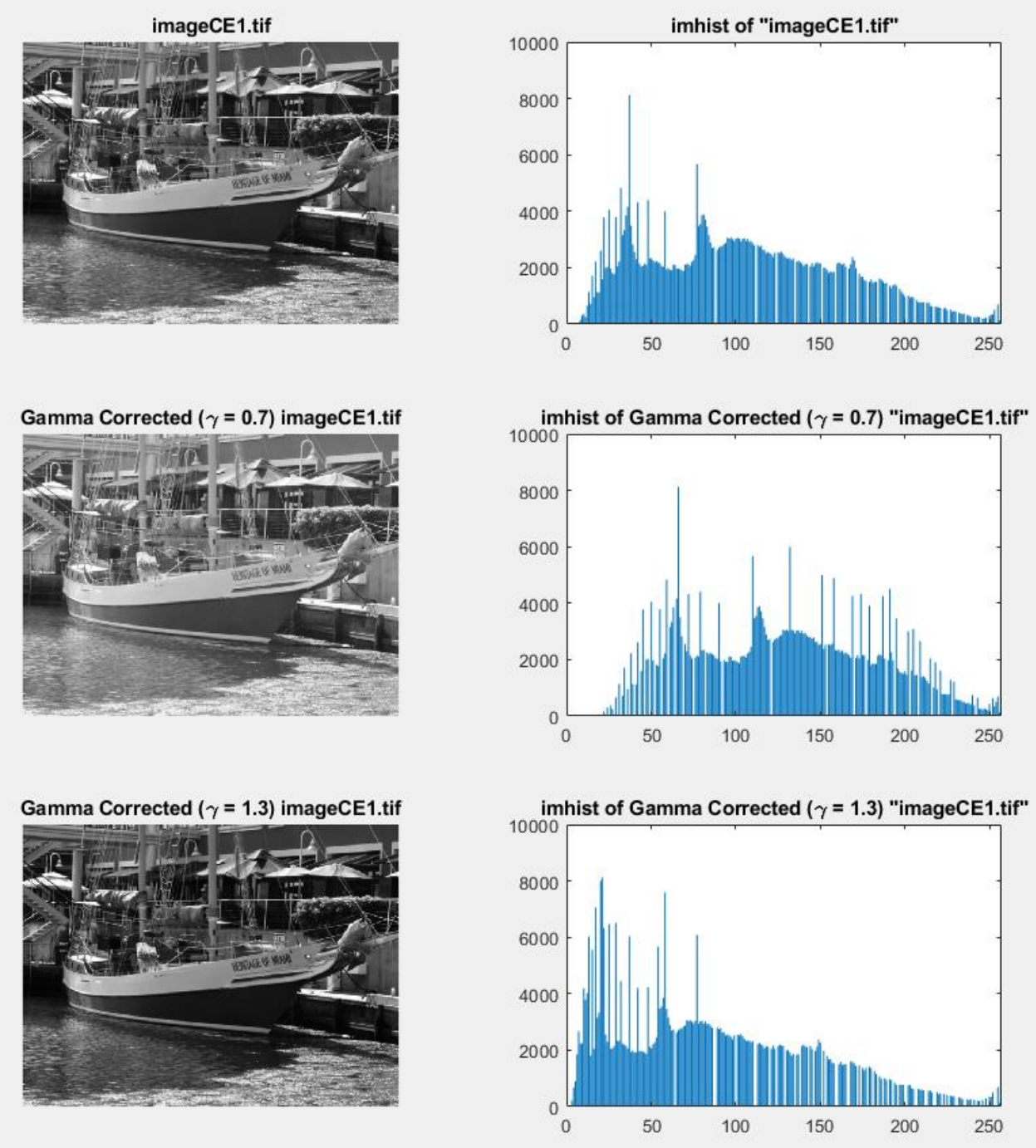

Figure 9: imageCE1.tif (Original, Gamma Correction of 0.7, Gamma Correction of 1.3)

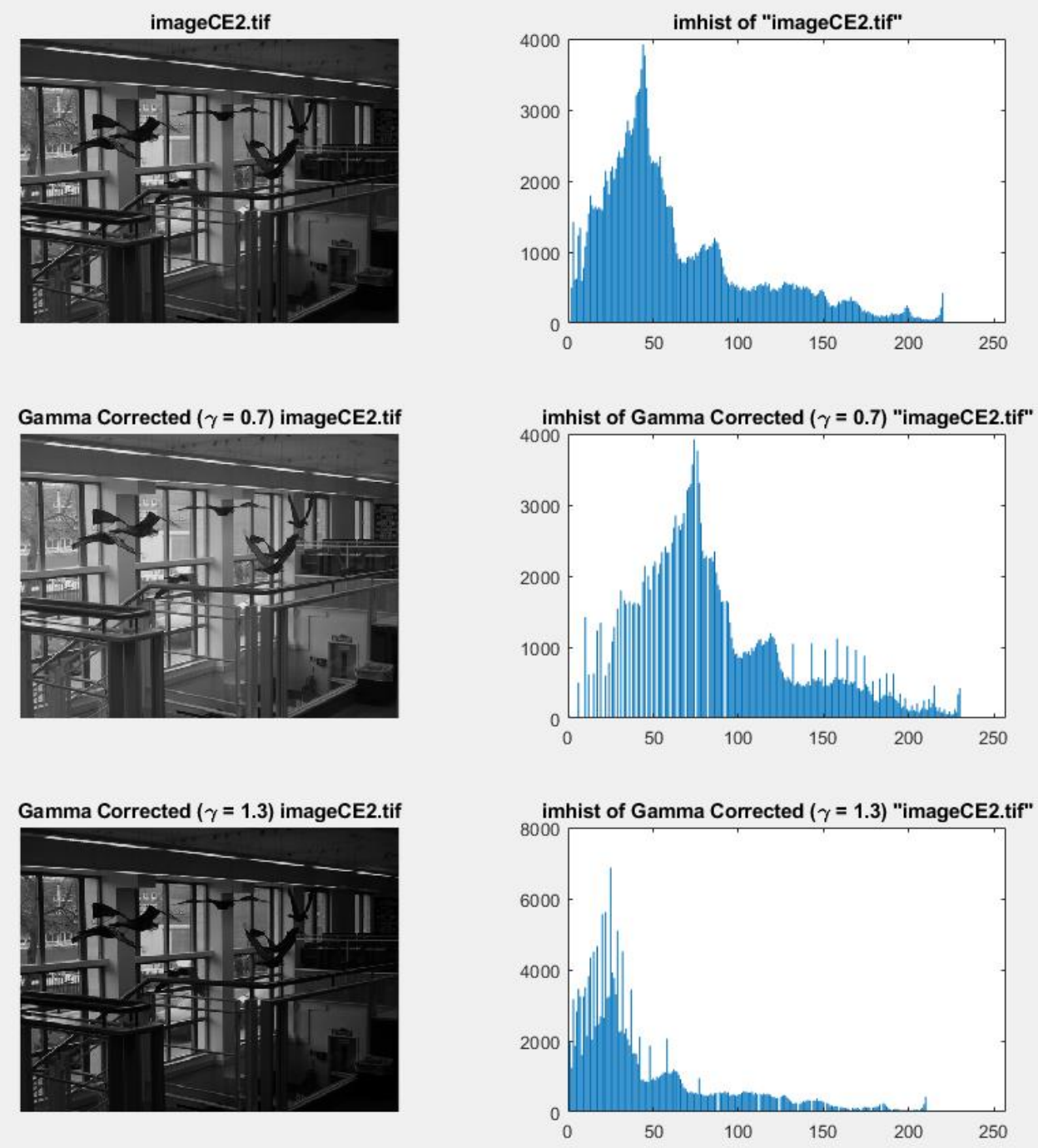

Figure 10: imageCE2.tif (Original, Gamma Correction of 0.7, Gamma Correction of 1.3)

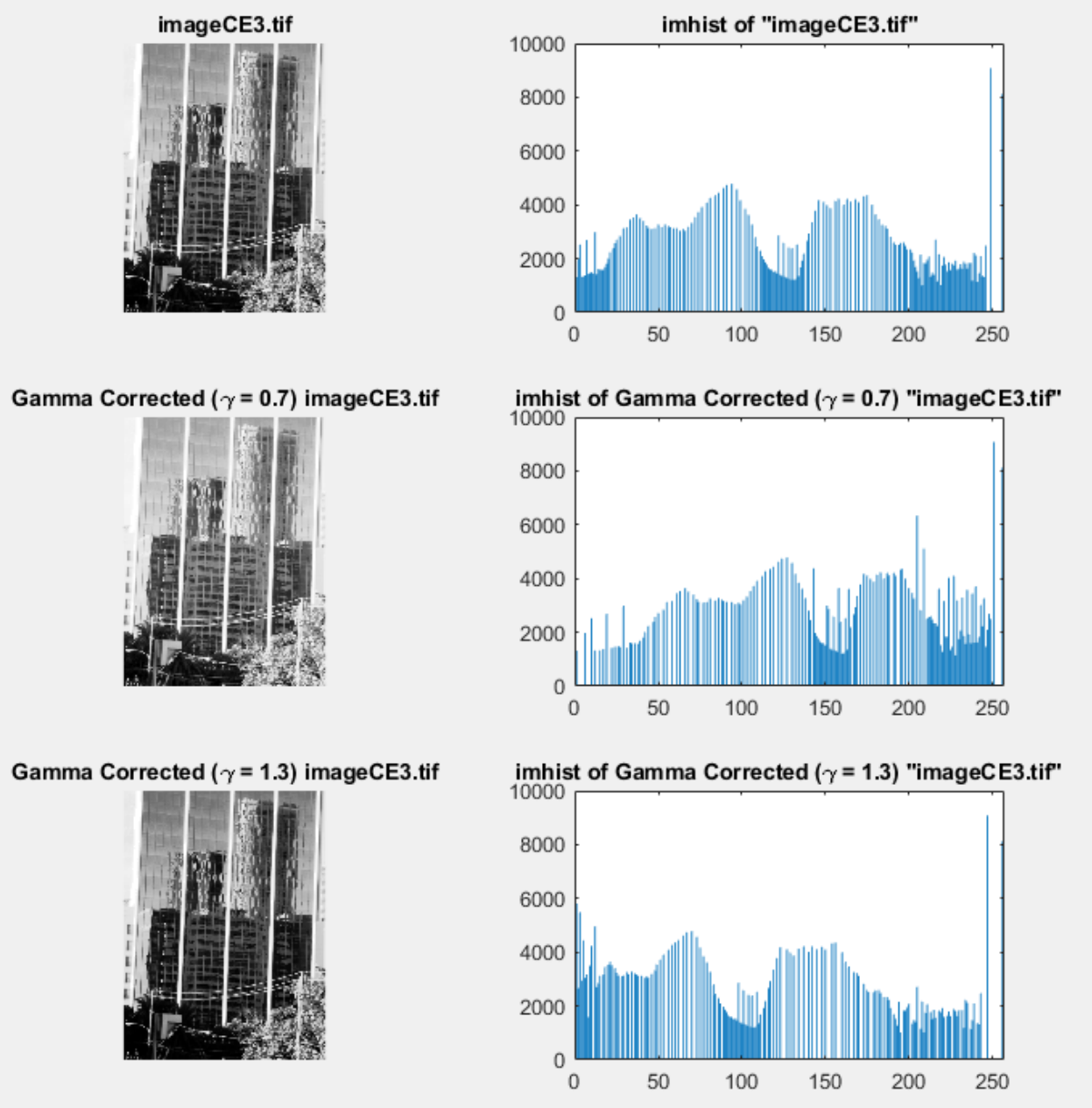

Figure 11: imageCE3.tif (Original, Gamma Correction of 0.7, Gamma Correction of 1.3)

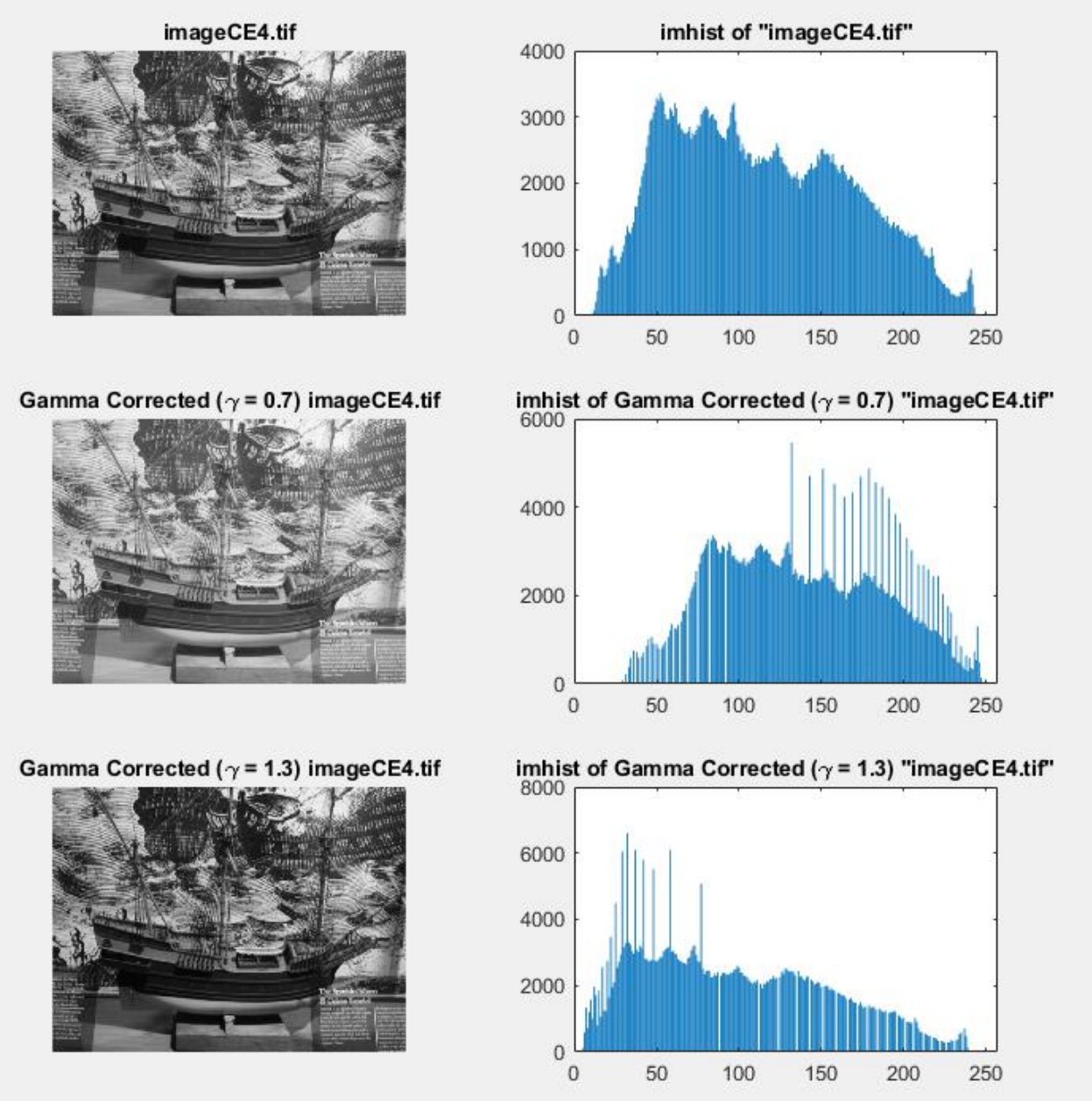

Figure 12: imageCE4.tif (Original, Gamma Correction of 0.7, Gamma Correction of 1.3)

The unaltered image pixel histograms dictate the general shape that the altered histograms follow. As the unaltered image's histogram gradually increases or decreases, these increases and decreases can be seen in the altered image's histogram.

A gamma value of 0.7 appears to shift the entire histogram of the images towards the center (or more towards the right). For *imageCE1.tif*, *imageCE2.tif*, and *imageCE4.tif*, a gamma value of 0.7 appears to introduce impulsive spikes towards the middle and higher end of the spectrum. It also appears to spread out these impulsive spikes throughout the entire histogram.

A gamma value of 1.3 appears to shift the entire histogram of the images towards the left. For *imageCE1.tif*, *imageCE2.tif*, and *imageCE4.tif*, a gamma value of 1.3 appears to introduce and more heavily concentrate impulsive spikes towards the lower end of the spectrum.

Figure 13: imageCE5.tif

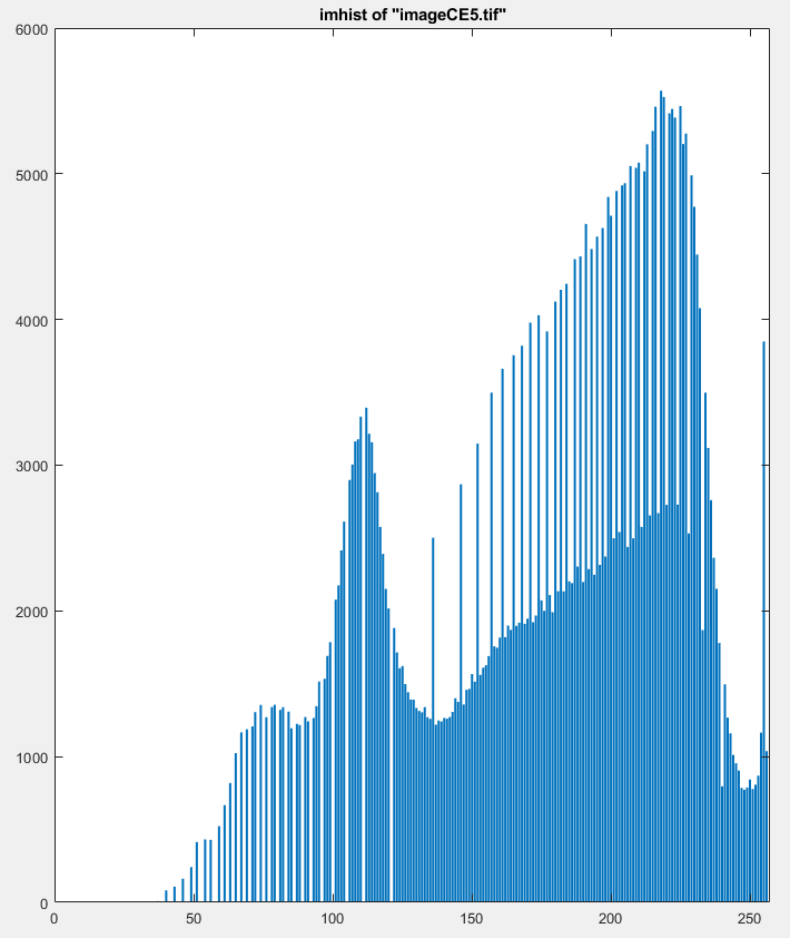

Figure 14: imhist of imageCE5.tif

According to the pixel value histogram of *imageCE5.tif*, it appears as though the region between 40 and 120 (approximately) are locally expansive. This is shown by the gaps between the bars in the bar graph. The region between 140 and 240 (approximately) are locally contractive due to the impulsive spikes introduced. These impulsive spikes are a product of certain regions overlapping, creating sharp (non-smooth) spikes. Based off of this information, it appears as though the gamma value is less than 1.

Part 2 – Detecting Image Resampling and Resizing

Using the *pmap* function created, the four images' pmaps were estimated using Kirchner's algorithm. Figure 15 shows the pmap for resamp1. This image indicates evidence of image resampling. This image has some color distortion, most noticeably in the top right corner. Figure 16 shows the pmap for resamp2. This image does not indicate evidence of image resampling. Figure 17 shows the pmap for resamp3. This image does not indicate evidence of image resampling. Figure 18 shows the pmap for resamp4. This image indicates evidence of image resampling. There is color distortion all over the image as seen in Figure 18.

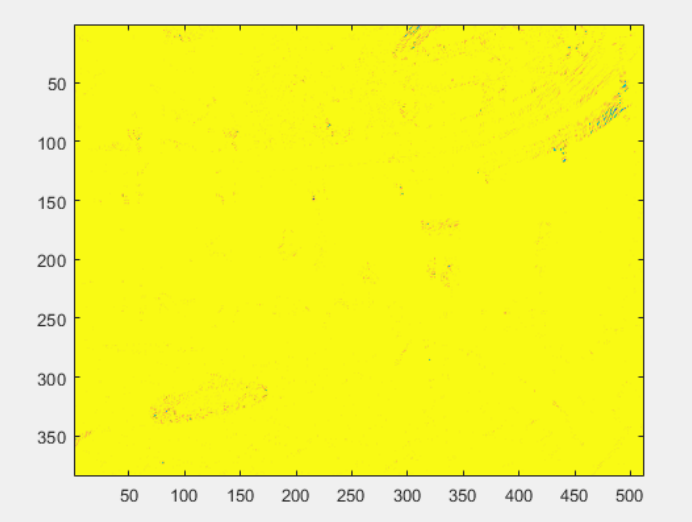

Figure 15: The estimated p-map of 'resamp1'

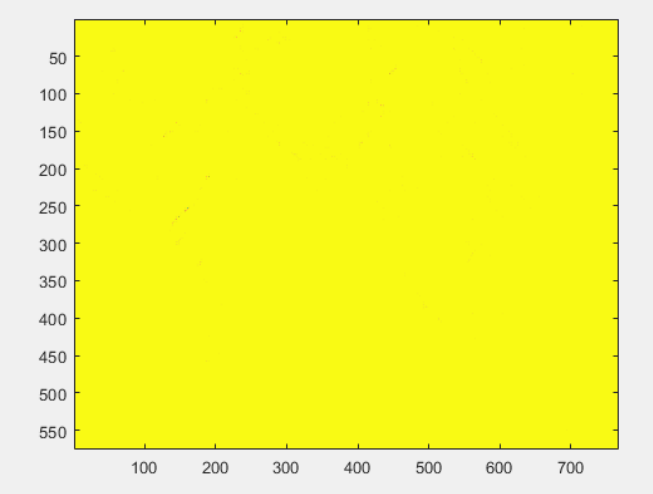

Figure 16: The estimated p-map of 'resamp2'

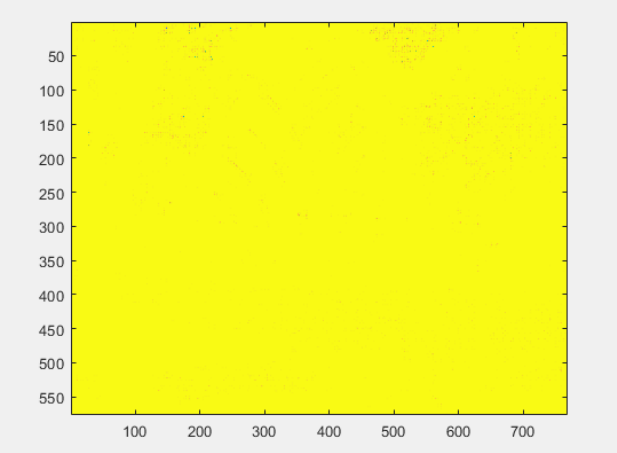

Figure 17: The estimated p-map of 'resamp3'

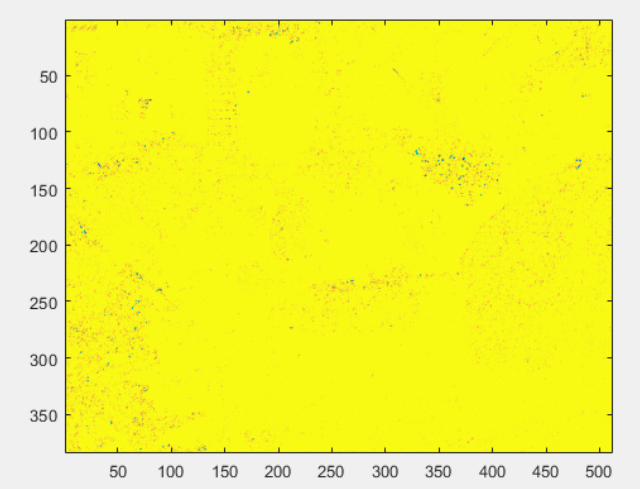

Figure 18: The estimated p-map of 'resamp4'

The frequency graphs of the p-maps were generated using the *showFreqPmap* code provided. Figures 5 through 8 shows these generated frequency charts. Figures 6 and 7, which correlate to resamp2 and resamp3, show contrast enhancement fingerprints. The fingerprints can be viewed by looking at the red circles present on Figure 20 and Figure 21.

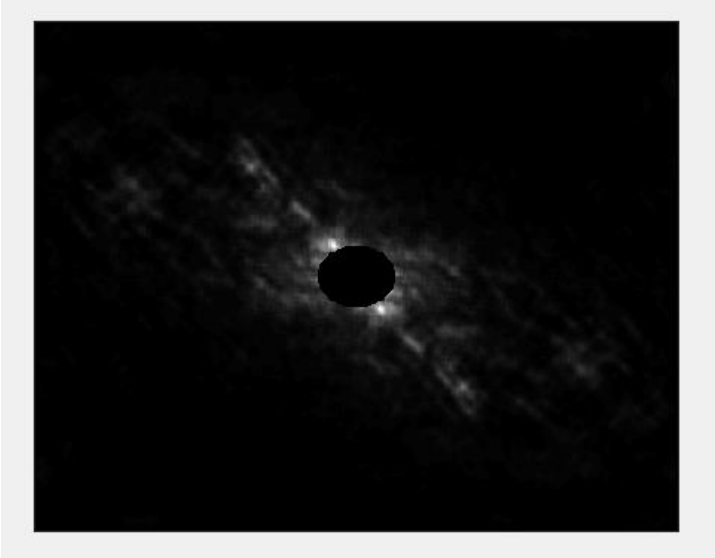

Figure 19: The frequency graph of p-map of 'resamp1'

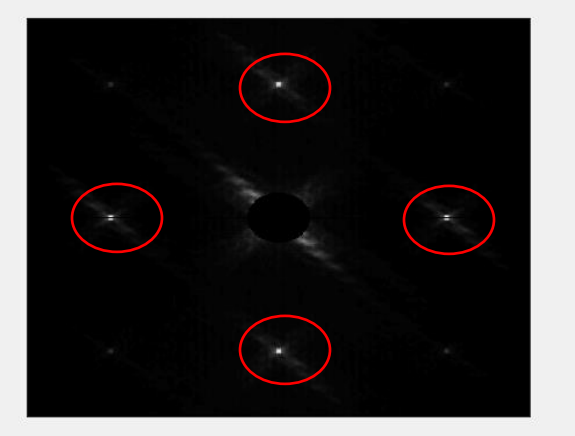

Figure 20: The frequency graph of p-map of 'resamp2'

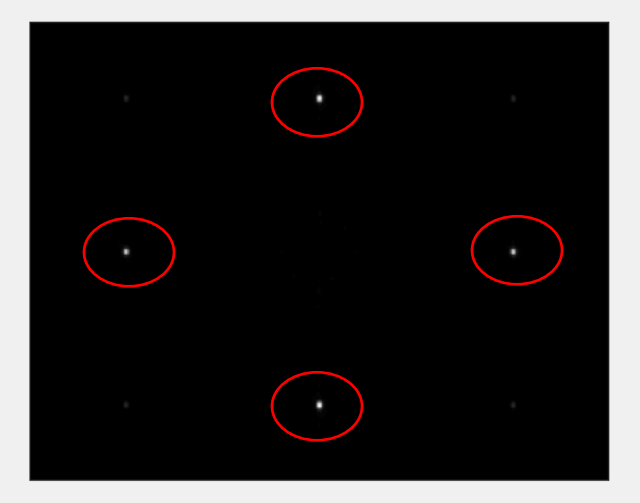

Figure 21: The frequency graph of p-map of 'resamp3'

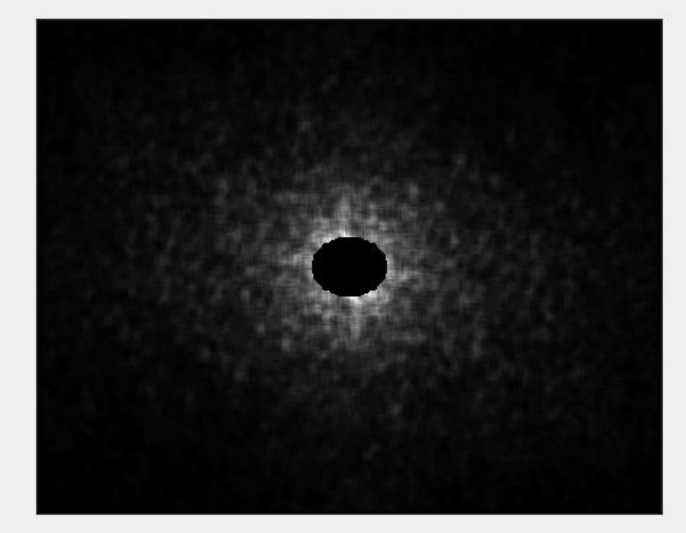

Figure 22: The frequency graph of p-map of 'resamp4'