Ikhlas Attarwala / Fall 2019
EECS 331 / Computational Photography
Group #9 (w/ Yunhao Li, Deanna Dimonte)

HDR Radiance Evaluation & Tone Mapping

Couple things before I begin:

- I ran out of time and didn't want to turn in the assignment late, therefore,
  - My code is very inefficient
  - I did not get to try out the Reinhard tone-mapping operator
  - This report is pretty short
  - Sorry

This week we looked at studying the dynamic range properties of our tablet, ie. evaluating irradiance and response curves based off of varying exposure times. We began by writing a program to capture images in a setting that wasn't too bright or too dim. We evaluated the pictures as we took them so that we would include images ranging in exposure levels from those that did not have any pixels with intensity values of 255, to those that had about 20% of total pixels with intensity values of 255. The exposure times are the titles of each image. In this case, I use the image folder 'THIRD SET', in my submission, with a choice of 12 images.

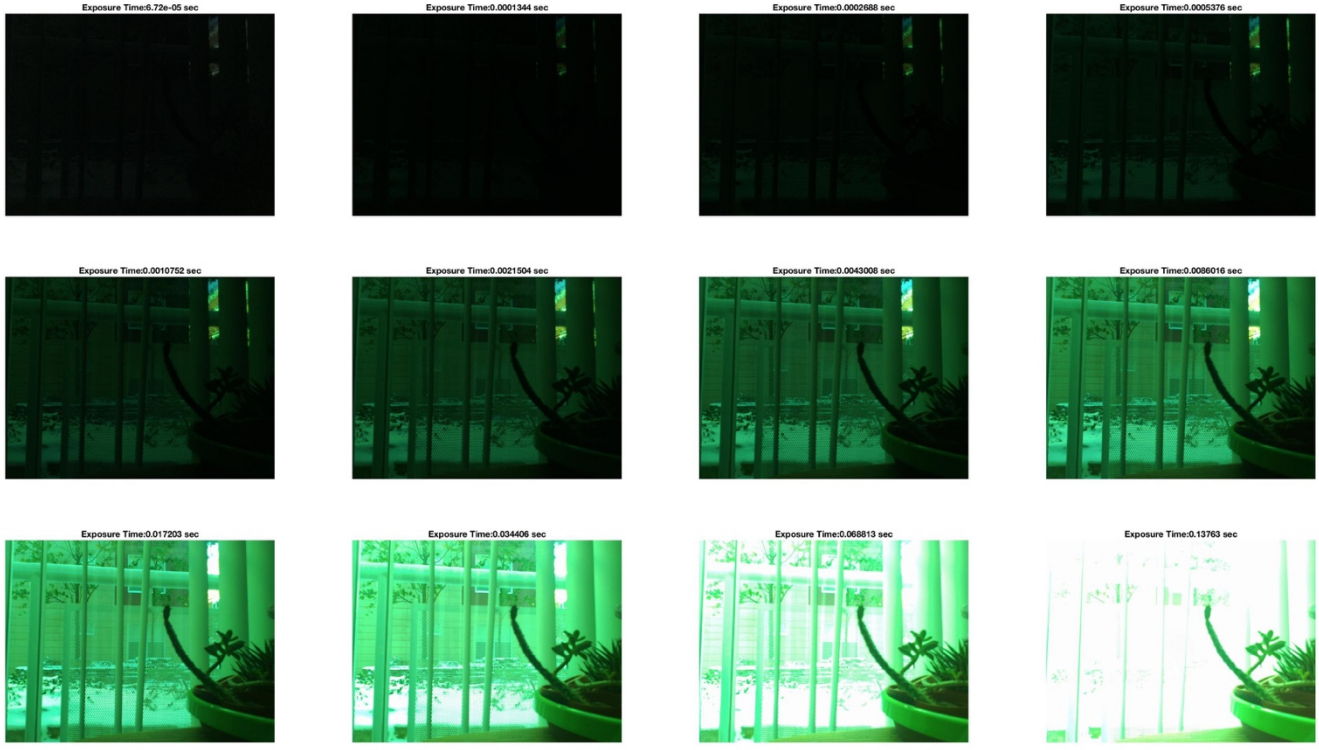

Figure 1: The 12 images I used

Now given all my pixels per location per exposure time, I want to evaluate for a response function and an irradiance value per pixel. The equation provided

$$g(Z[i,j] = \ln(E[i]) + \ln(B[j])$$

Evaluates this response function for me per pixel 'i' for the exposure time in seconds 'j'. We tried different lambda ranges and found that increasing lambda (smoothes our fitted line). Additionally, it seemed like more values along the blue channel had less variance than the red channel, and the green channel had a slightly higher log exposure at greater pixel values (Z[i,j]) than the red and blue channels.

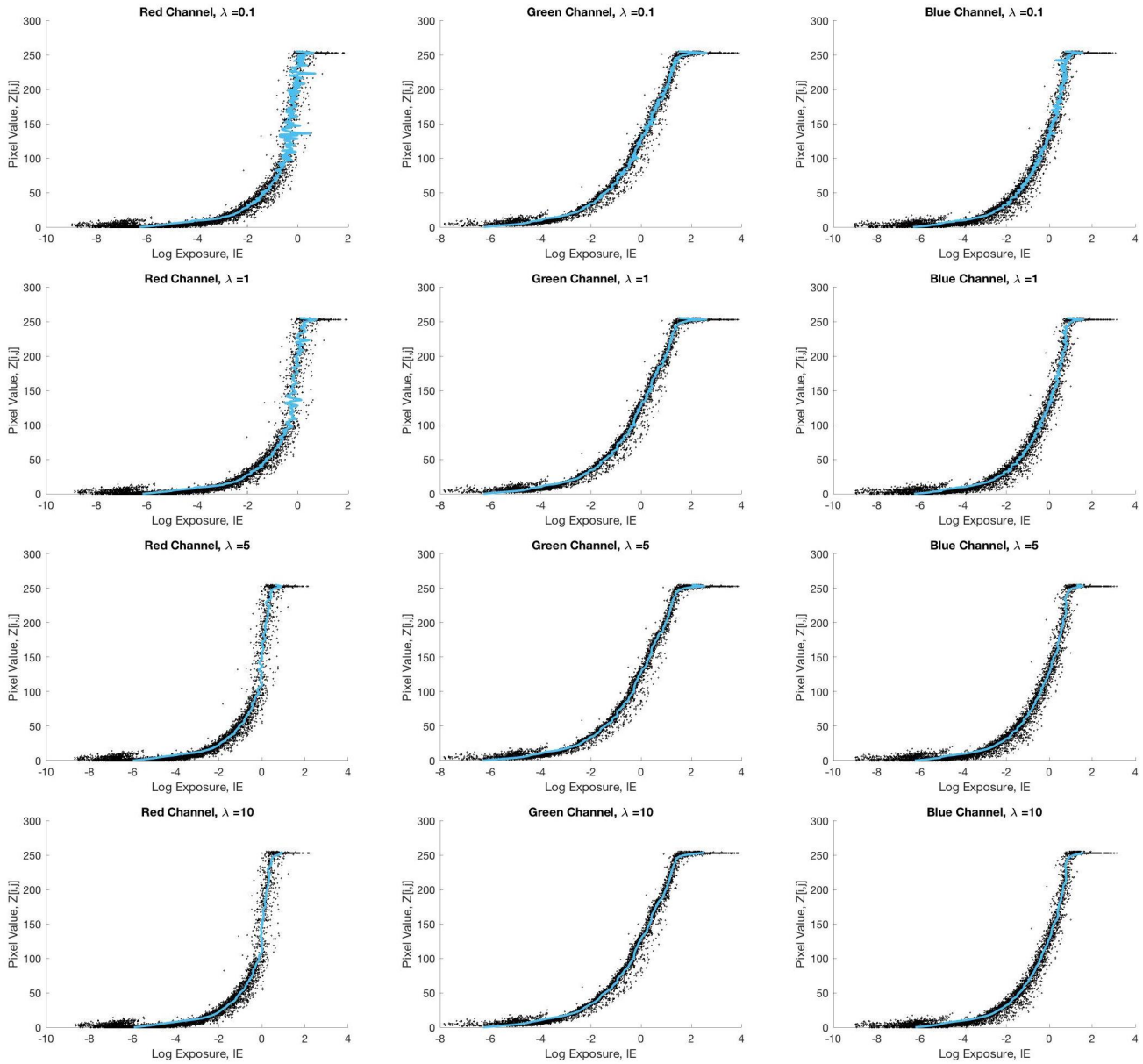

Figure 2: Our camera response curve (RGB channels; lambda = [.1, 1, 5, 10])

Now we wanted to recover the radiance image from the sequence of exposures, and we did this by taking the above equation for ln(E[i]), and dividing the sum of the difference of Z[i,j] and B[j] by the number of pictures we used in the evaluation (12 images). I plotted our radiance results by differing lambda scores (just curious). I found there wasn't any change across lambda, which struck me as odd because it was a piece of the original equation, but the color channels showed differences. Dynamic range appears to be 10^2.5.

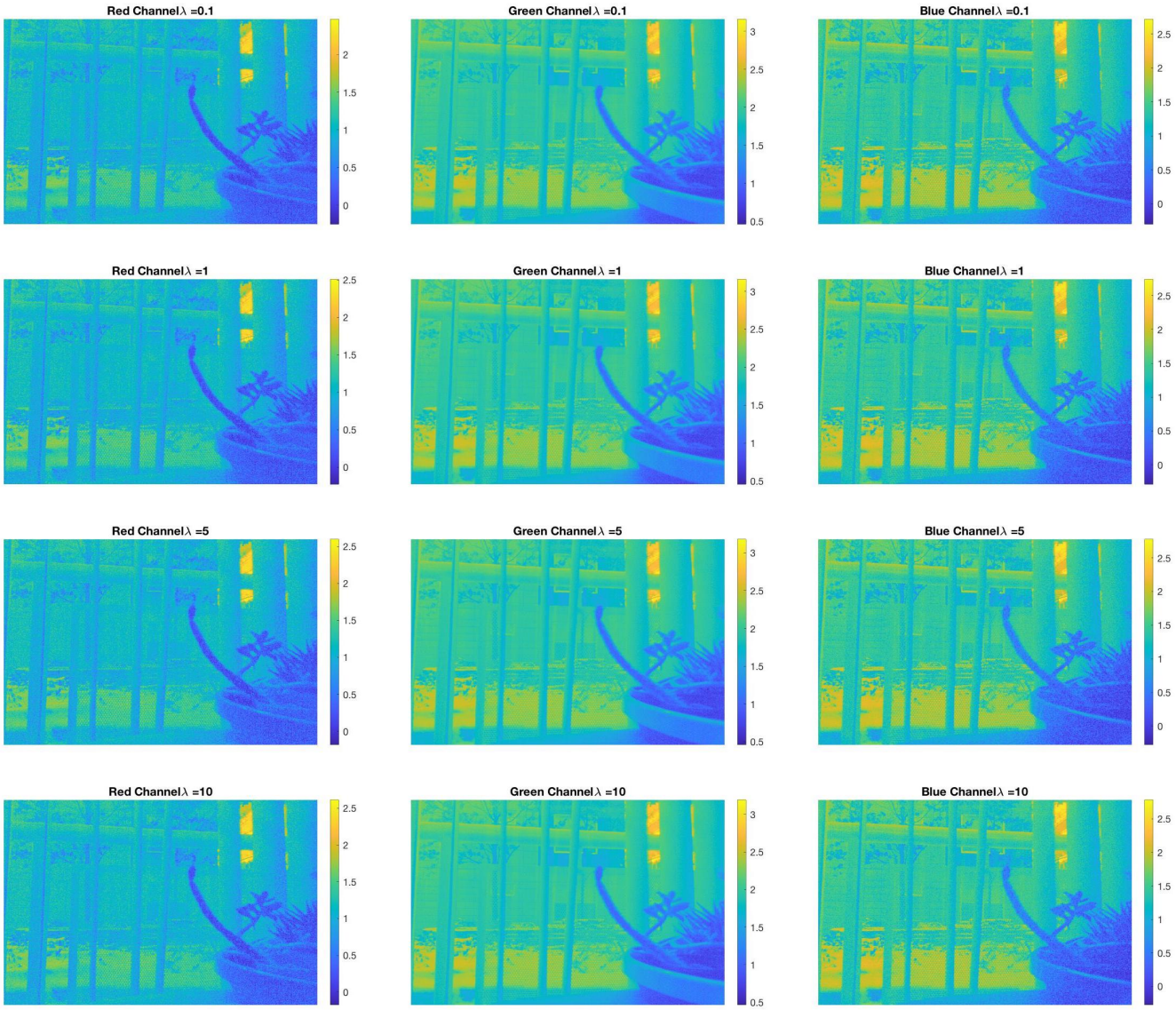

Figure 3: HDR radiance maps per color channel (observed no change due to lambda)

Tone-mapping allows us to map one set of colors to another to approximate the appearance of HDR images such that they have a less dynamic range. First we scale the brightness to values between 0 and 1, and then we apply a gamma curve to the image to observe how it affects the images. In my opinion, the gamma value at .75 seemed more or less appropriate. I'm afraid I did not get to the Reinhard tone-mapping operator.

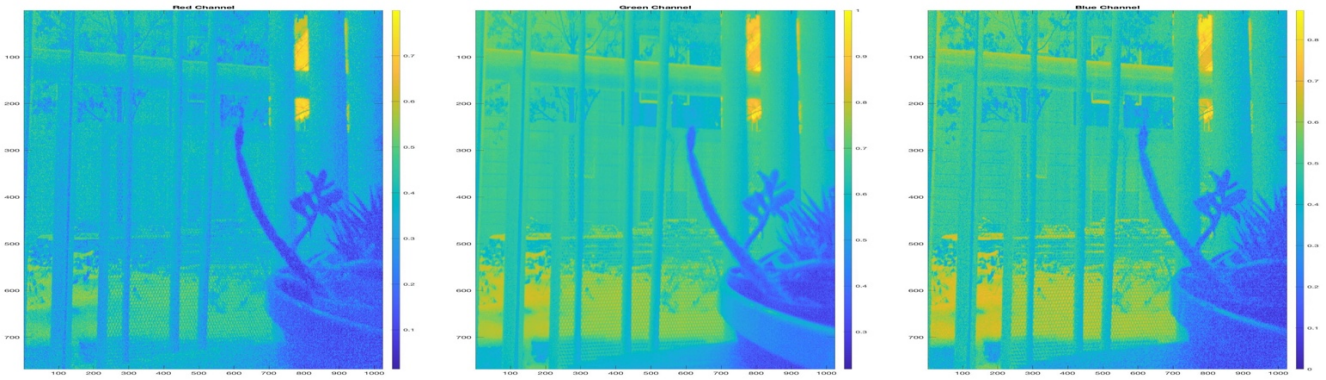

Figure 4: RGB color channels have their brightness scaled

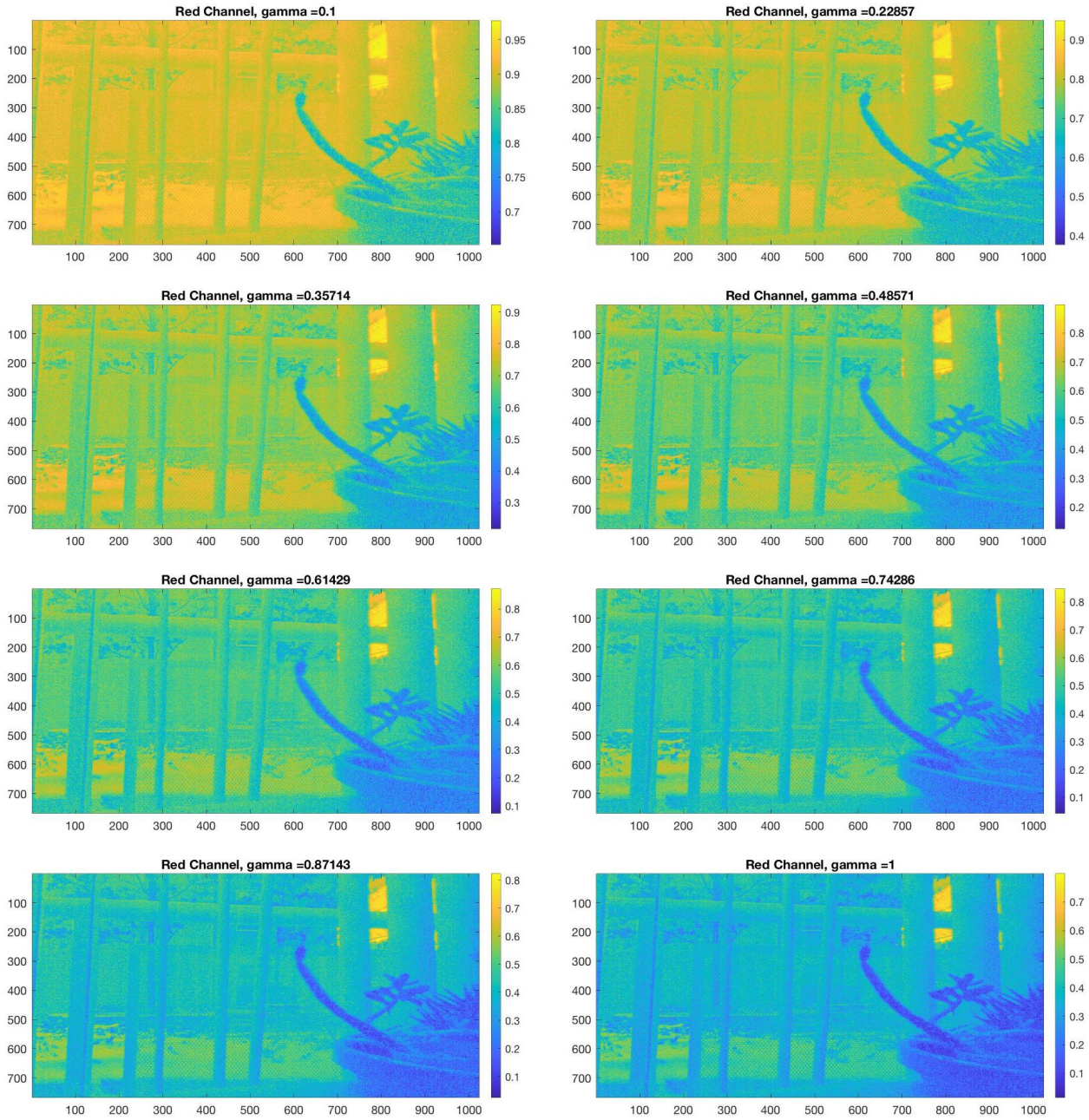

Figure 5: Different gamma curves applied to the image