CSCE448-500 Project 6

Lam Nguyen

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1 High Dynamic Range (HDR)

1.1 Overview

In this assignment, the task is to take a set of images with varying amounts of exposures to be able to construct a high dynamic range through a series of procedures. The general idea behind this is that for all the images for a particular subject, the camera response function will be calculated by:

1. Read the images and their exposures
2. Randomly select N pixels to perform the optimization. Where N is a reasonable value.
3. Use the triangle function defined in Eq. 4 of the Debevec's paper
4. Using the provided gsolve, perform the optimization.

And the result of finding the camera response function can be used to find the radiance map of a subject via Eq. 6 of Debevec's paper via:

$$ln(E_i) = \frac{\Sigma_{j=1}^{P} w(Z_{ij})(g(Z_{ij}) - ln(\Delta t_j)}{\Sigma_{j=1}^{P} w(Z_{ij})}$$

where Z is the image, w is the triangle function, g is the CRF, and t is the exposure

And then use either global tone mapping or local tone mapping to be able to retrieve a visible image from that radiance map via:

Global

$$T = (\frac{E}{max(E)})^{\gamma}$$

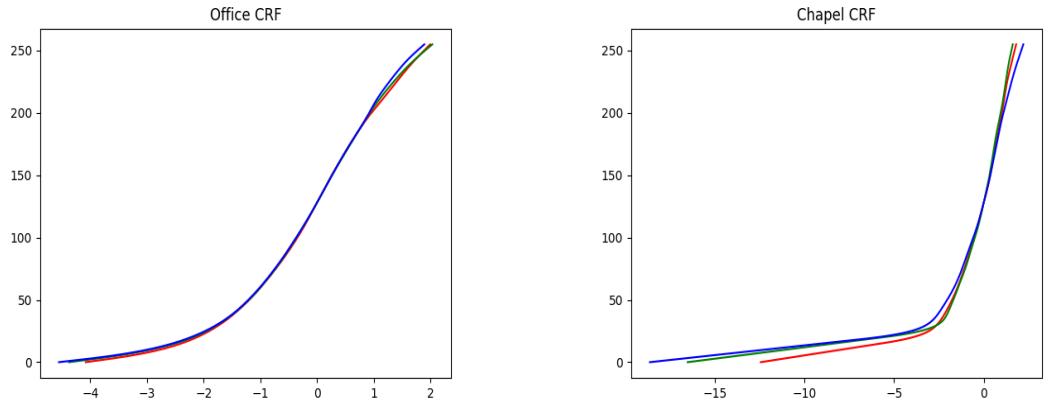
Local

1. Find the detail layer
2. Find the base layer
3. Find the color layer
4. Combine them together to get final image

The result of the radiance should be where ever the light is the highest will have the warmest color (colors like orange or red), and the resulting image should be sharp and clear.

1.2 Results

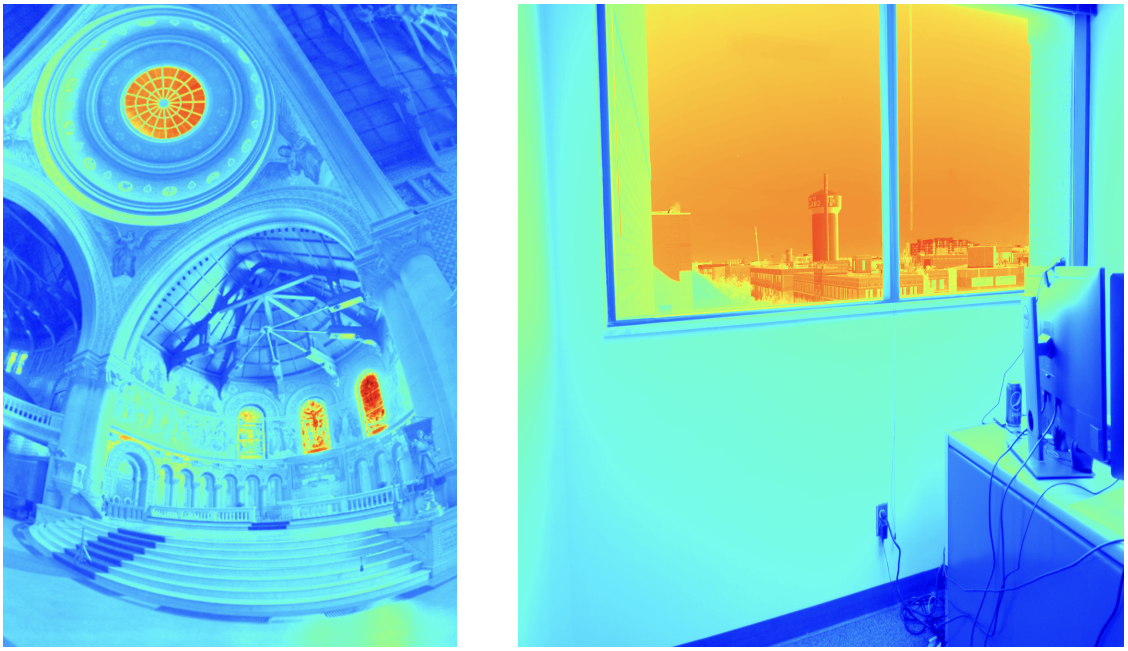
Given the images, the camera response function can be seen below for both the chapel and the office:



(a) Office CRF (b) Chapel CRF

Figure 1: Camera Response Function Plots

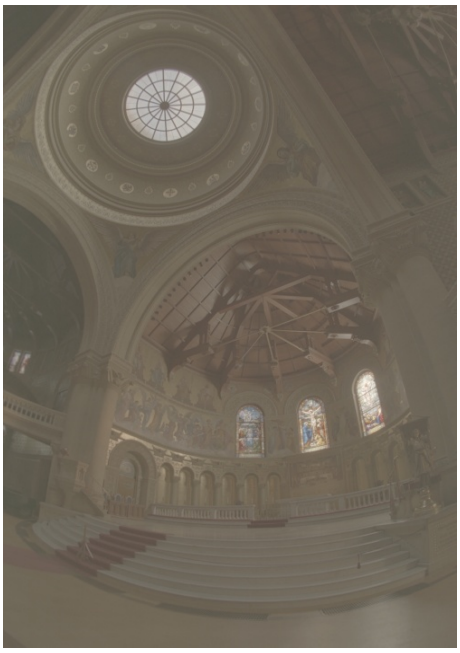
Then from the CRFs, the radiance maps can be found for both images:



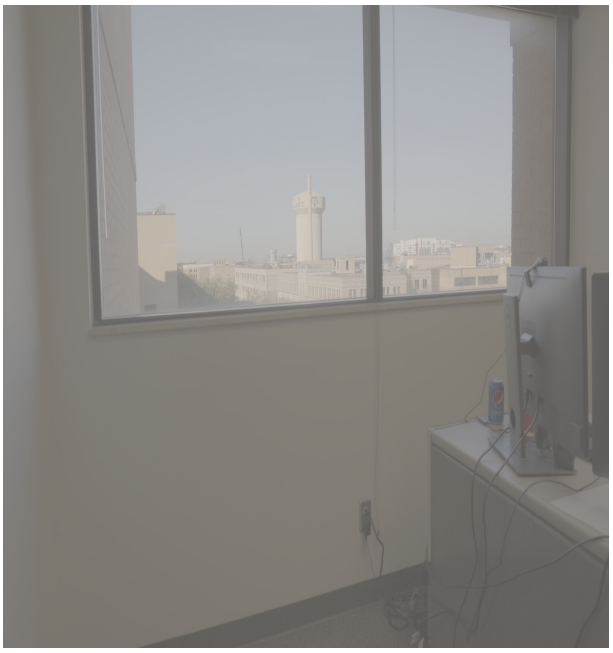
(a) Chapel Radiance (b) Office CRF

Figure 2: Radiance Maps

Then to view the images, we need to tonemap them through our two methods:

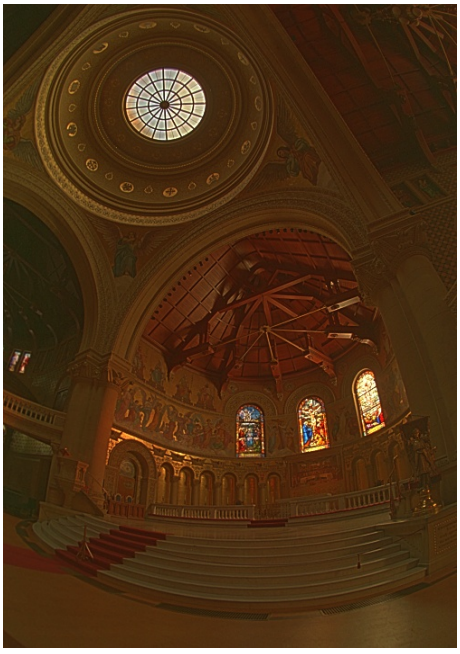


(a) Chapel w/ Global Tonemapping

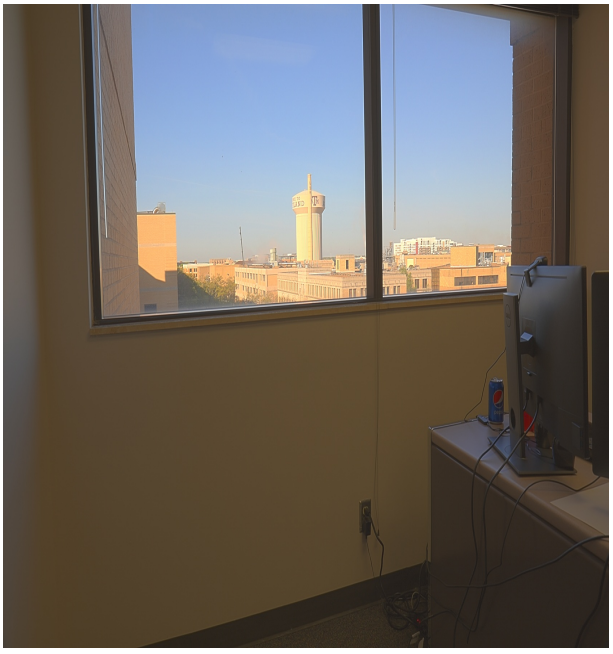


(b) Office w/ Global Tonemapping

Figure 3: Global Tone Mapped Result



(a) Chapel w/ Local Tonemapping



(b) Office w/ Local Tonemapping

Figure 4: Local Tone Mapped Result

1.3 Analysis

For the most part, the resulting images from tone mapping are close to the actual provided and found online. One thing I found that was quite annoying and difficult during this project was that the images are read in BGR format, but I had my images in RGB, so it took forever to debug my project. As well as the computation for the radiance is extremely slow at $O(c * h * w * n)$, where c is the color channels, h is the height of an image, w is the width of an image, and n is the number of images for a subject. Though an alternative to speed things up is to vectorize the computations.