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CS 445 - Project 4: Image Based Lighting

Complete the claimed points and sections below.

Total Points Claimed	**[120] / 210**
Core	
1. Recovering HDR maps	
a. Data collection	[20] / 20
b. Naive HDR merging	[10] / 10
c. Weighted HDR merging	[15] / 15
d. Calibrated HDR merging	[15] / 15
e. Additional HDR questions	[10] / 10
2. Panoramic transformations	[10] / 10
3. Rendering synthetic objects	[30] / 30
4. Quality of results / report	[10] / 10
B&W	
5. Additional results	[ ] / 20
6. Other transformations	[ ] / 20
7. Photographer & Tripod removal	[ ] / 25
8. Local tone-mapping operator	[ ] / 25

1. Recovering HDR maps

(a) Your LDR images (if you took your own)



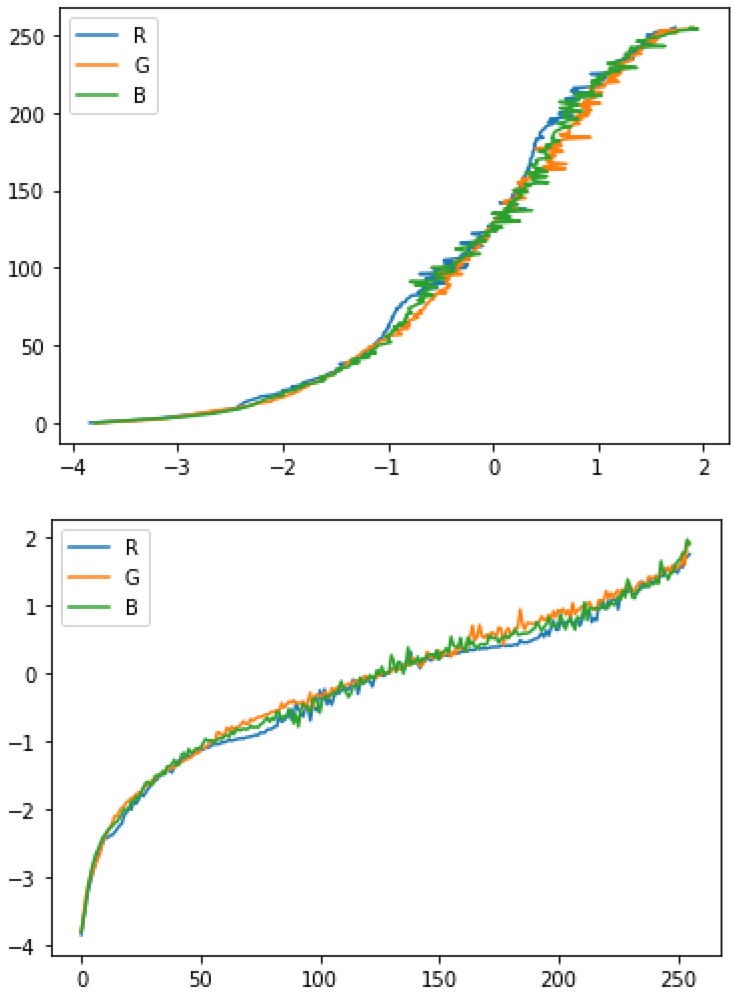
1/13, 1/50, 1/201 shutter speeds, respectively. I chose to omit the slower shutter speeds because the exposure bracketing feature took them at 1/11s and appeared to artificially increase exposure. As a result, they didn't add much information to the image.

(b) Figure of rescaled log irradiance images from naive method



(d) Figure of rescaled log irradiance images from calibration method

(d) Plots of g vs intensity and intensity vs g



(b-d) Figure comparing the three HDR methods

(b-d) Text output comparing the dynamic range and RMS error consistency of the three methods

```
naive:          log range =  13.779     avg RMS error =  4.247
weighted:       log range =  13.863     avg RMS error =  4.245
calibrated:     log range =  15.687     avg RMS error =  2.074
```

(e) Answers to the questions below

Note if you claim credit for data collection, you must use your own images for parts 1-3

Answer these questions:

1. For a very bright scene point, will the naive method tend to overestimate the true brightness, or under-estimate? Why?

The naive method will tend to overestimate the true brightness, since for very bright spots, the corresponding pixels will be bright for all exposure times. When averaged, the resulting pixels will still be very bright. There is no compensation for over-exposed regions, so the naive method will overestimate their true brightness. The weighted method fixes this by weighting the over-exposed areas less, producing a result closer to the true brightness.

2. Why does the weighting method result in a higher dynamic range than the naive method?

The weighting method results in a higher dynamic range since it more heavily weighs pixel intensities close to 128/255. It essentially takes the correctly exposed (not under or over-exposed) parts of each image at different shutter speeds. This results in a selection of pixels within a pretty small range, ignoring the extreme intensities (close to 0 or 255) and resulting in a lower log range than for the naive method. When the sum of irradiations are converted back to pixel intensities between 0 and 1, the small range is stretched further than before, displaying a higher dynamic range.

3. Why does the calibration method result in a higher dynamic range than the weighting method?

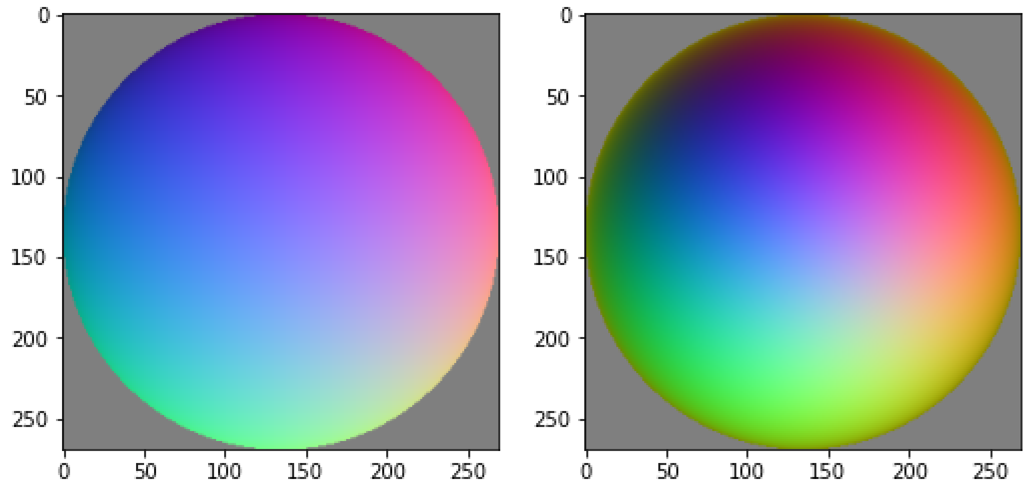
The calibration method results in a higher dynamic range than the weighing method because it maps more effectively from pixel intensity to irradiance than the linear function used in the weighing method. While the weighing function uses linear changes in weights, the calibration method uses a curve, so it more effectively reduces the highest and lowest intensities of the image. The calibration method is likely to make the brightest points weigh even less than the linear weighing method due to the shape of the matching curve being more like an 'S' than a straight line. This better centers pixels around the desired intensity of 128 and ignores extreme pixel intensities, causing a smaller log range and resulting in a higher dynamic range.

4. Why does the calibration method result in higher consistency, compared to the weighting method?

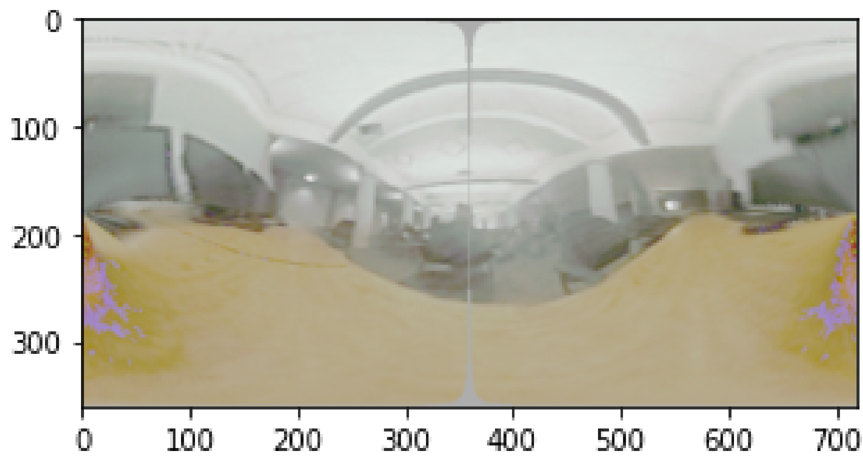
The calibration method results in higher consistency because the calibration method allows for a more accurate mapping from pixel intensity to log irradiance. Since it maps more accurately than either other method, the resulting log irradiances are closer to the true value. Every image/scene is going to require a different camera response function to accurately recreate true intensities, so using a naive or weighted function is a one-size fits all approach that will not work as well between different images or camera sensors. The calibration method accounts for the unique light characteristics of each image and camera to create a suitable response function, increasing consistency of results and reducing the RMS error compared to the other methods.

2. Panoramic transformations

The images of normal vectors and reflectance vectors, respectively:



The equirectangular image from your calibration HDR result



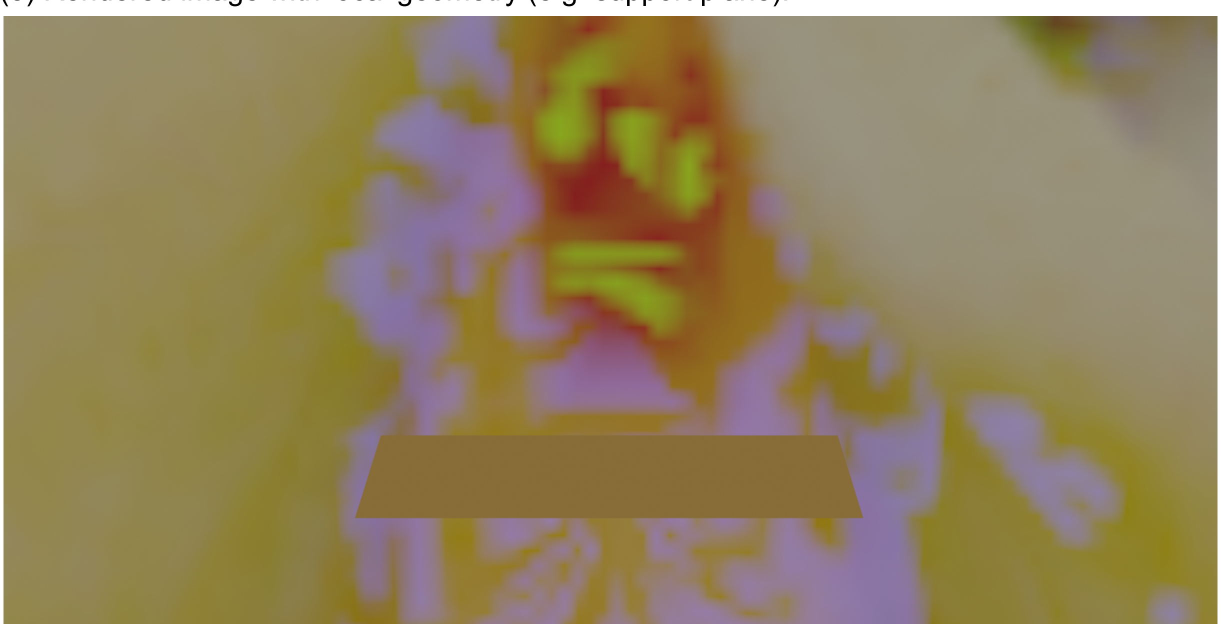
3. Rendering synthetic objects

Component images:

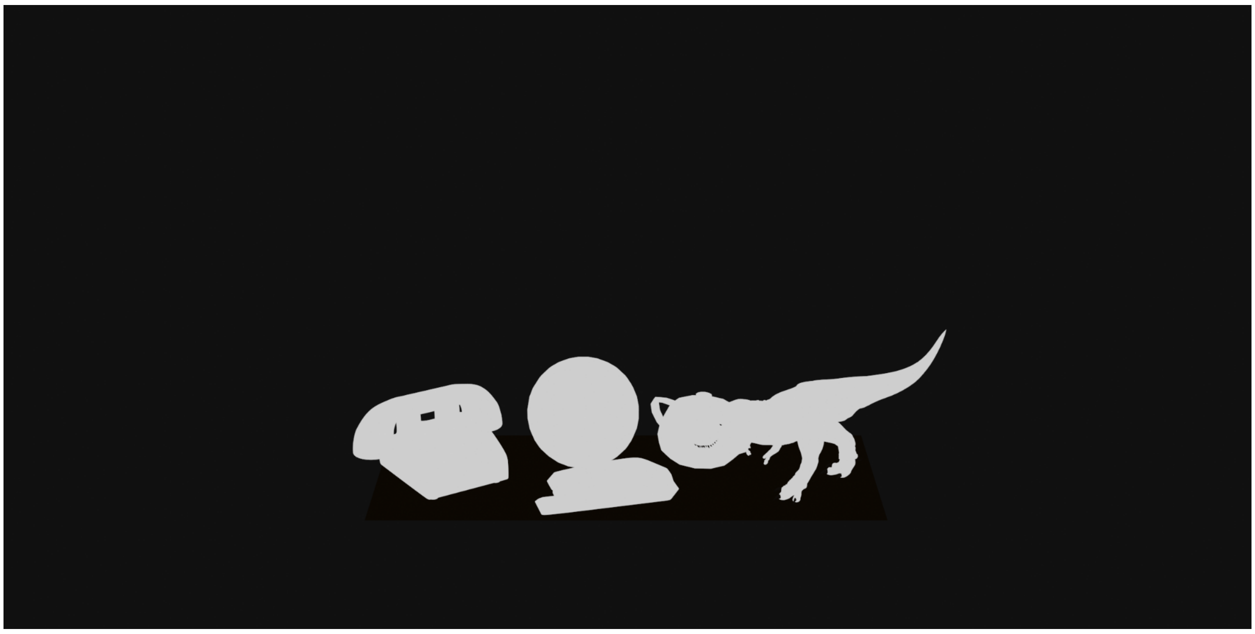
(1) Background image:

(2) Rendered image with objects:

(3) Rendered image with local geometry (e.g. support plane):



(4) Rendered mask image:



(5) Final composited result:

4. Quality of results / report

Nothing extra to include (scoring: 0=poor 5=average 10=great).

5. Additional results (B&W)

Include background image and final composited result image for: (10 pts each)

- New objects, same environment map
- New environment map, same objects

6. Other transformations (B&W)

Include (10 pts each)

- Angular environment map
- Vertical cross environment map

7. Photographer and tripod removal (B&W)

Include:

- Original LDR images
- Equirectangular image created from your own photos without photographer
- Explain your method

8. Local tone-mapping operator (B&W)

Include:

- Displayed HDR image, computed as linearly rescaled log of HDR image
- Your HDR image display improved by tone mapping
- Explain your method

Acknowledgments / Attribution

List any sources for code or images from outside sources

https://www.turbosquid.com/3d-models/simple-rotary-phone-c4d-free/547814
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