

Kayson Ijisesan (tijis2)
CS 445 - Project 4: Image-Based Lighting

1. Recovering HDR maps

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



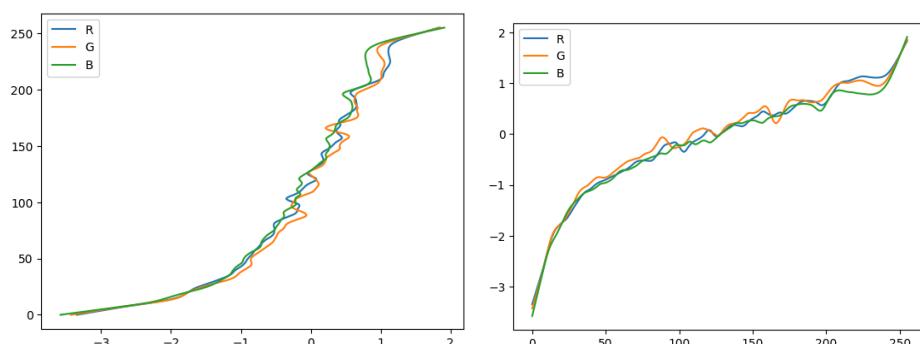
(c) Figure of rescaled log irradiance images from weighted method



(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 = 6.626 avg RMS error = 0.335

weighted: log range = 6.933 avg RMS error = 0.293

calibrated: log range = 6.79 avg RMS error = 0.258

(e) Answers to the questions below

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

The naive method will tend to over-estimate the true brightness for very bright scene points. This is because the naive method averages irradiance values from all images without considering exposure limits. This means that extremely bright pixels that are overexposed in one or more images are included in the final HDR calculation. Since overexposed areas in LDR images reach the maximum pixel intensity and lose detail, they contribute a high but incorrect brightness value, which leads to an over-estimation of 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 because it gives higher weights to pixel intensities that are well-exposed and lower weights to under or over exposed pixels. By doing this, it reduces the influence of saturated and very dark pixels, which would otherwise distort the irradiance estimate. This leads to the dynamic range of the final image having a larger range of intensities compared to the naive method.

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

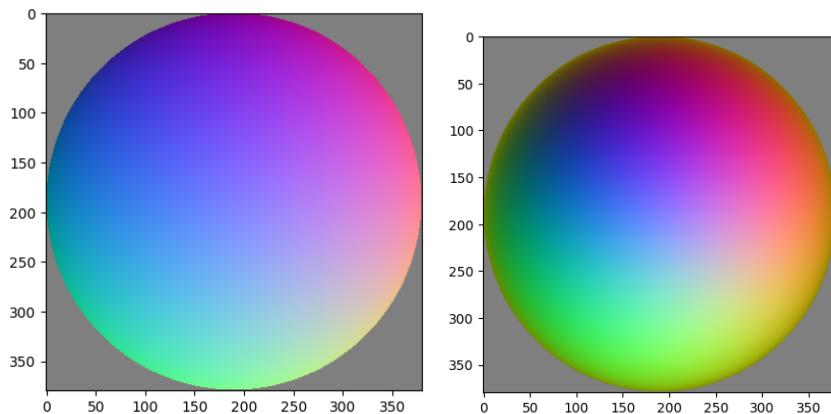
The calibration method results in a higher dynamic range than the weighting method because it uses the camera's response function, which helps to map pixel intensities more accurately to their irradiance values. This helps to adjust for non-linearities in the camera's response to light and that the intensity values are properly scaled across images with different exposure times. The calibration method captures a more accurate range of brightness levels, which results in an HDR image with a higher dynamic range.

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

The calibration method is able to have a higher consistency compared to the weighting method because it uses the response function so that intensities throughout the images are mapped consistently to irradiance values, no matter the exposure time. This adjustment minimizes inconsistencies caused by non-linear camera responses and intensity differences. The calibration method reduces these differences in brightness across similar intensities in different images, resulting in a HDR image with more consistency across the image.

2. Panoramic transformations

The images of normal vectors and reflectance vectors

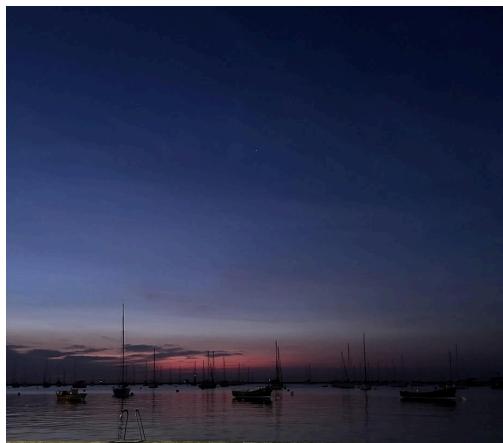


The equirectangular image from your calibration HDR result

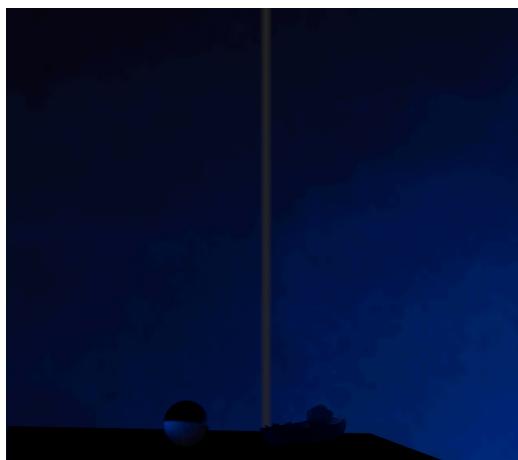


3. Rendering synthetic objects

Background image



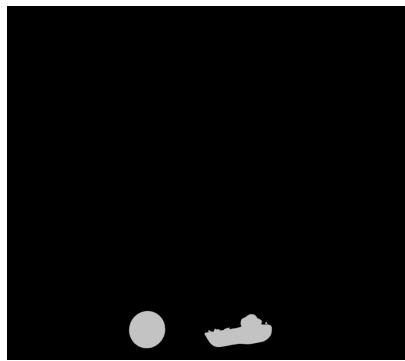
Rendered image with objects



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



Rendered mask image

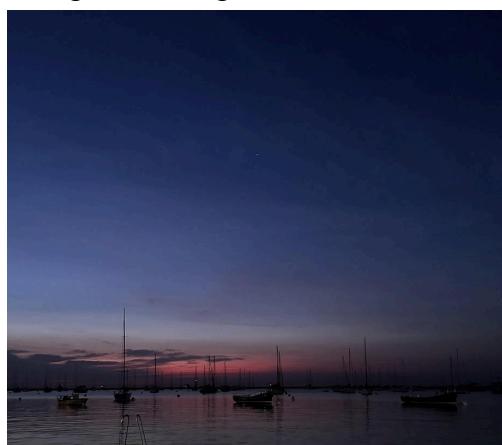


Final composited result

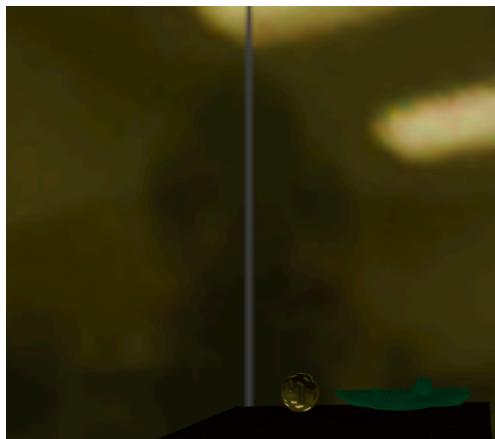


2nd Result

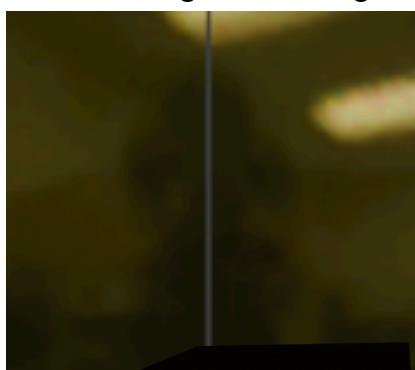
Background image



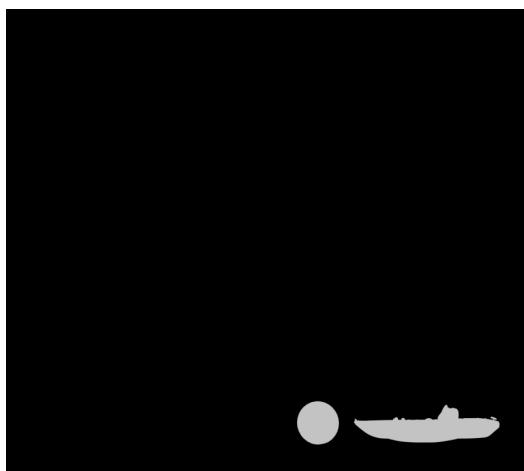
Rendered image with objects



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



Rendered mask image



Final composited result



Acknowledgments / Attribution

3D Model of Kayak - Artec3D

<https://www.artec3d.com/3d-models/kayak>

Environment Mapping

https://web.archive.org/web/20180202014433/http://www.luxrender.net/wiki/Environment_map

Einsum

<https://stackoverflow.com/questions/26089893/understanding-numpys-einsum>

Naive LDR Merging

https://en.wikipedia.org/wiki/High_dynamic_range#High-dynamic-range_imaging

Debugging and HDR explanations

ChatGpt

Calculating Weighted Average for Pixel Intensity

<https://stackoverflow.com/questions/12819592/weighted-mean-in-python-numpy>

Camera Response Function in Photography

[https://en.wikipedia.org/wiki/Response_function_\(photography\)](https://en.wikipedia.org/wiki/Response_function_(photography))

Spherical to Equirectangular Transformations

<https://stackoverflow.com/questions/40818936/project-3d-sphere-to-equirectangular-image>

Calculating Weighted Average for Pixel Intensity

<https://stackoverflow.com/questions/12819592/weighted-mean-in-python-numpy>