Smartphone Spectrophotometer Notes

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1 Introduction

2 Sensor Baseline

2.1 Compensating for Exposure

2.1.1 Aperture and Intensity

The aperture of, measured in f-stops, is the opening of the camera sensor. the f-stop measures the amount of sensors surface open to collect photons. Larger apertures create a smaller depth of field (should be considered when deciding on the baseline).

The intensity of the incident light is inversely proportional to the square of the f-number.

$$I \propto \frac{1}{f^2}$$

2.1.2 Shutter Speed and Intensity

We can assume that the shutter speed (how long the sensor collects photons), is inversely proportional to the measured intensity.

$$I \propto \frac{1}{T}$$

2.1.3 Pixel values

If the pixel value is an estimate of the power per solid angle per area of the sensor, we can combine the shutter speed and aperture relations as

$$I \propto \frac{1}{T \cdot f^2}$$

3 Absorbance Model

3.1 Lambertian BRDF

Assuming a diffuse reflection and rotational symmetry of the secchi disk, we can assume the Lambertian BRDF to be as constant, with the form,

$$f(\theta_i, \phi_i; \theta_r, \phi_r) = \frac{\rho_d}{\pi}$$

The ρ_d is the albedo of the secchi disk.

Inside the water column with the assumption that the light source is normal to the surface, the surface radiance is then,

$$L = \frac{\rho_d}{\pi} I_0$$

Where, I_0 is the intensity of the incident light.

Note: The intensity of light in the water will lower than the intensity of light outside. (The incident light will need to take into account Fresnel Diffraction possibly?)

4 References

References

[1]