Modeling Lens Effects Using MATLAB

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Applying Lens Effects

- Effects can be applied to images once they are transformed into matrices using functions of pixel location.
- These effects only apply to a single color, so an effect must be applied three times, for full color.

Figure 1

Figure 2

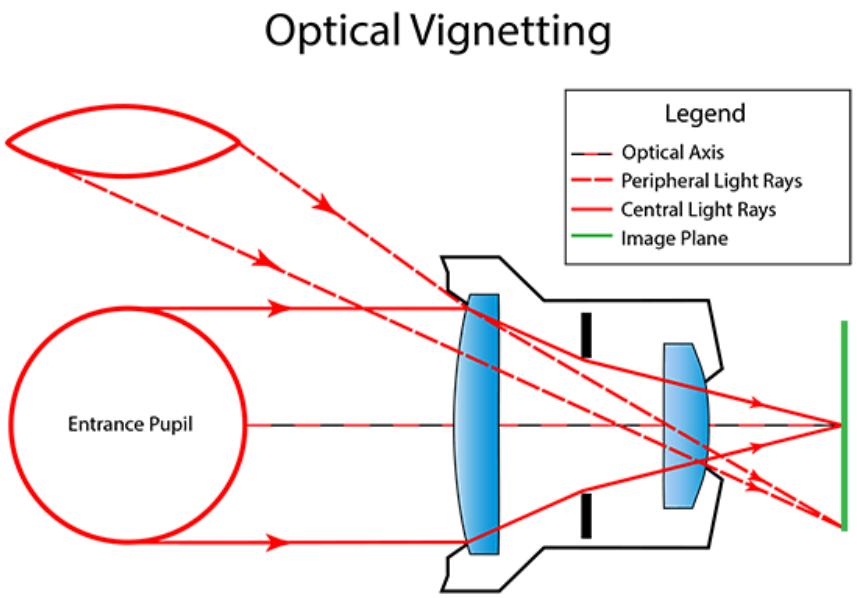
Figure 3

Figure 4

Figure 1 is the original image, before any effects were applied. Figure 2 shows a vignette applied. Figure 3 shows radial distortion applied, and figure 4 shows a vignette and radial distortion applied.

Vignettes

- A vignette occurs because imperfect lenses refract differently towards the edge, and less light reaches a pixel in the center.[1]
- A vignette can be modeled by $\cos^4(\theta)$
- A vignette may be simulated in computer graphics for animation, etc…



https://cdn.photographylife.com/wp-content/uploads/2013/10/Optical-Vignetting.png

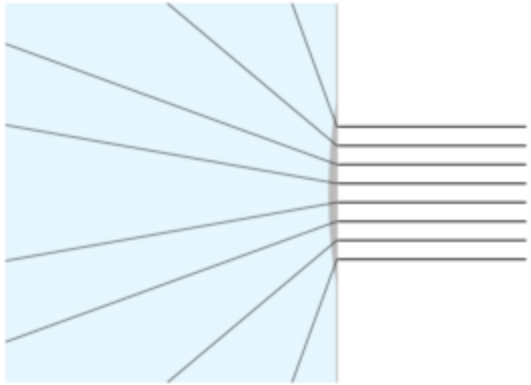
Vignetting

Vignetting simulated with $\cos^4(\theta)$

A real vignette due to an imperfect lens

Radial Distortion

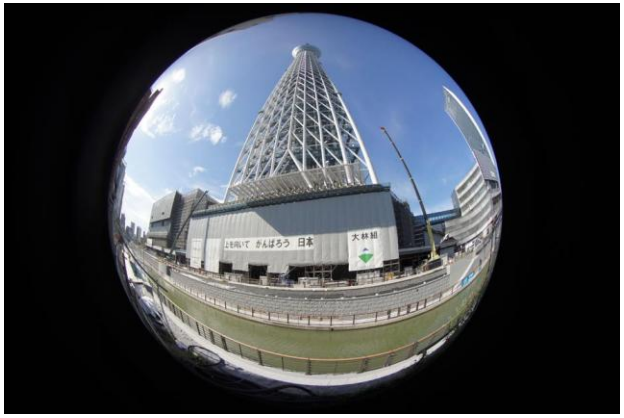
- Radial Distortion occurs as a lens artifact, due to a fish eye lens, or some kinds of zoom lenses[2]
- Radial Distortion can be modeled with a Taylor Series, a polynomial which as the degree increases, the function more closely matches the true, infinite series it models.[2],[3]



http://i.stack.imgur.com/Y4cJx.png

Radial Distortion (Fisheye)

Radial Distortion, applied using a forth order Taylor Series



Radial distortion caused by a fish eye lens

Radial Distortion and Vignetting

Multiple image effects can be applied to an image in series

References

1. https://en.wikipedia.org/wiki/Vignetting
2. https://en.wikipedia.org/wiki/Distortion_(optics)
3. https://en.wikipedia.org/wiki/Taylor_series

Code for this project is available at:
https://github.com/aakatz3/SPCS2015FinalProject/