

Background Information – Lens Aberrations

There are several ways by which lenses can distort an image. Firstly, a lens can cause blurring, a condition under which the light is not completely focused. This is an effect that is wavelength-dependent and is well known as chromatic aberration. This is also an effect that can depend on the position of the light in the field of view.

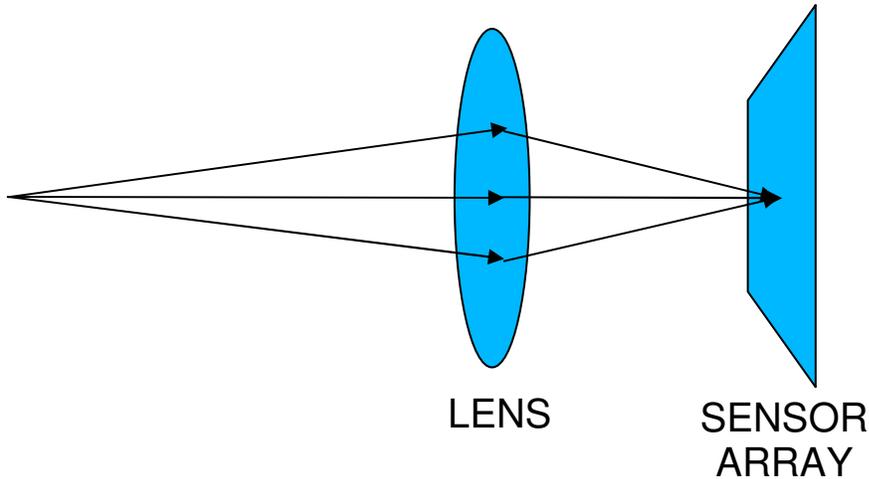


Figure 1: Simple model used for a digital imager.

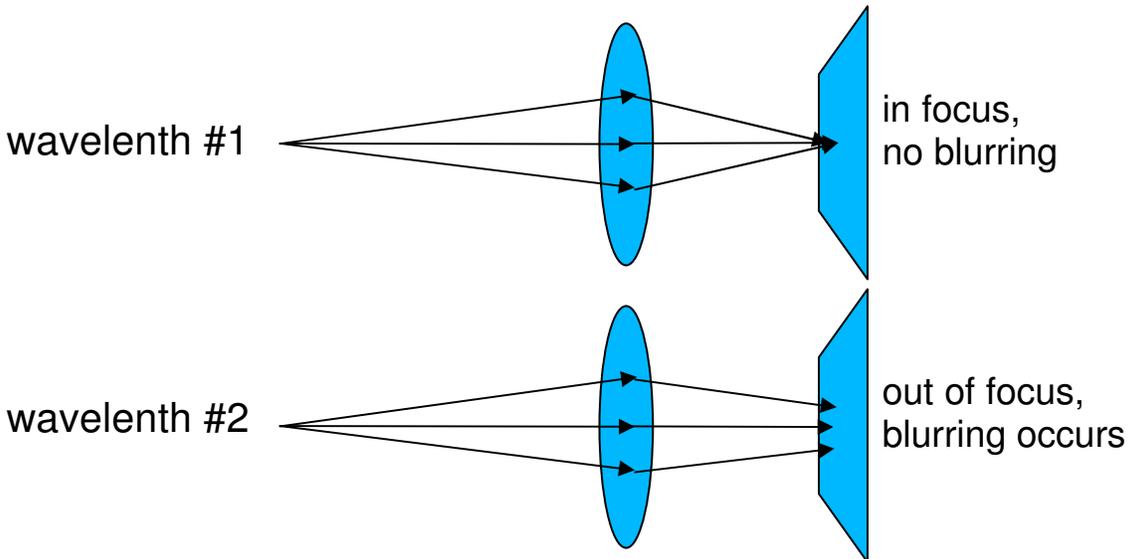


Figure 2: Wavelength-dependent aberration in lenses (chromatic aberration)

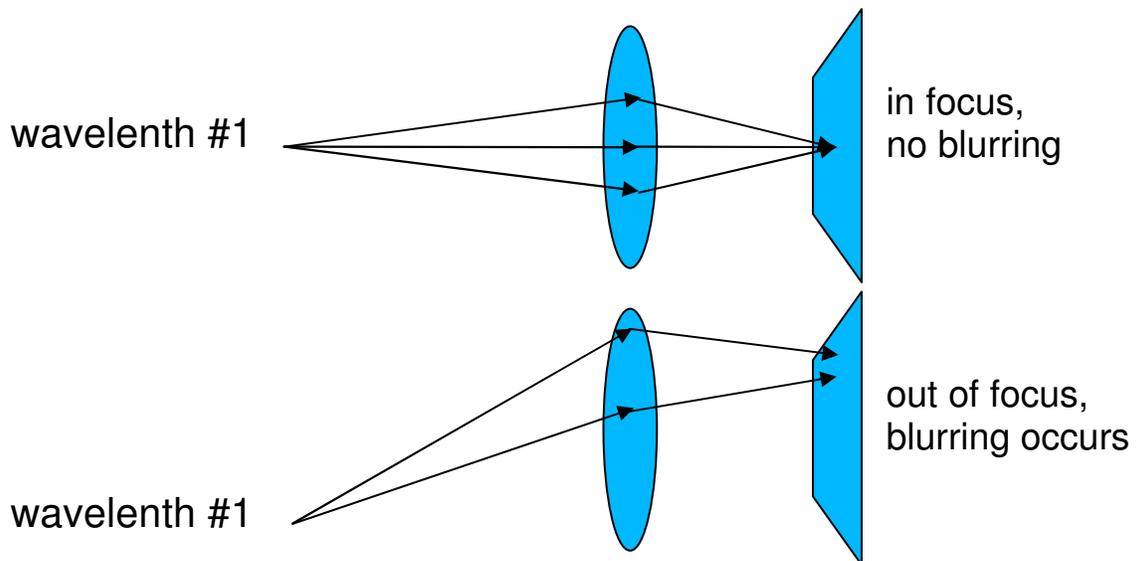


Figure 3: Position-dependent aberration in lenses

A aberration that is caused by lenses is photon reflection. Depending on the index of refraction of the lens, not all of the incident light will be transmitted through the lens. This is also an effect that is a function of the wavelength of the light (this is because the index of refraction is wavelength-dependent). Since the angle of incidence of incidence also matters, this aberration is also position-dependent (the position of the light in the field of view).

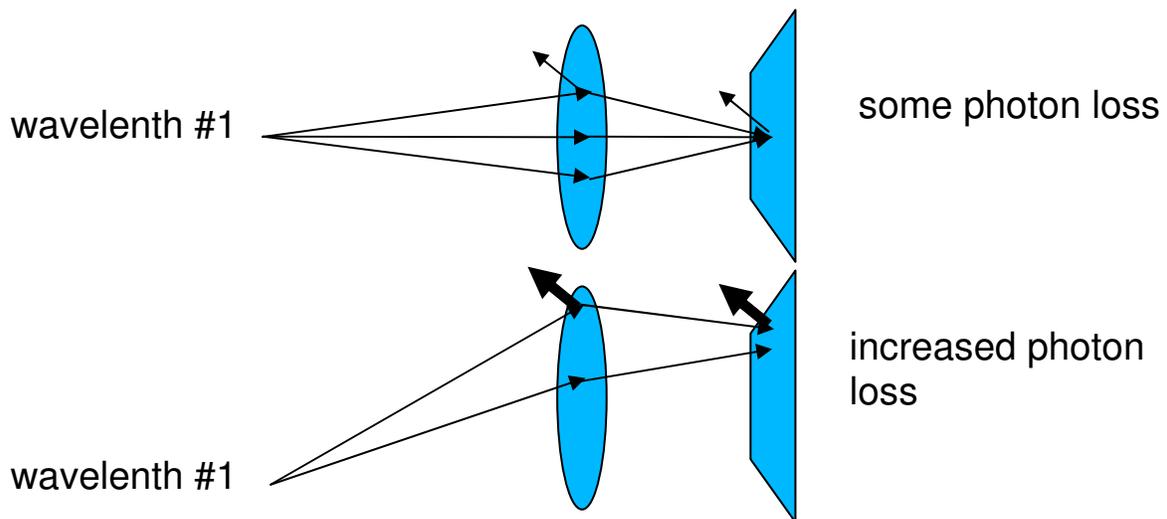


Figure 4: position-dependent photon scattering of image sensors. Image sensors also exhibit wavelength-dependent photon scattering (not shown in figure).

In summary, the lens aberrations discussed are categorized in the following table.

	Blurring	Photon Loss
Wavelength-Dependent	x	x
Position-Dependent	x	x