

Today:

- Finish cloud critiques
- Review exposure
- Resolution
 - Spatial
 - Temporal

Fri will talk about Measurand, aka Dynamic range, then on to Specific Flow Vis Techniques, starting with Dyes

Review of Exposure Choices

(1)

Shutter speed

slow

30 = 1/30 sec

60

120

240

480

4 ways to control pixel values

(2)

Aperture

big

4

5.6

8

11

16

f/16

(3)

ISO

1600 high sensitivity

800

400

200

100 low sensitivity

(4)

Deliberate over/under exposure

Overexposed = More light, or more sensitive ISO
EV = +1

Proper exposure = middle value on an average pixel

Underexposed = Less light, less sensitive
EV = -1

$$f\# = \frac{f}{D}$$

Short answer quiz: You want to increase brightness in your raw image. List the side effects of each method, beyond the effect on image brightness:

- 1) Decrease shutter speed in manual exposure mode keeping other parameters constant: aperture and ISO
- 2) Open up aperture in manual exposure mode, keeping shutter speed and ISO constant
- 3) Increase ISO in manual exposure mode, keeping aperture and shutter speed constant
- 4) Deliberate overexposure in any exposure mode



Decreased Shutter speed: motion blur at slow speeds

Aperture: low depth of field at large aperture. Diffraction will reduce sharpness at small apertures

ISO: Noise at high ISO

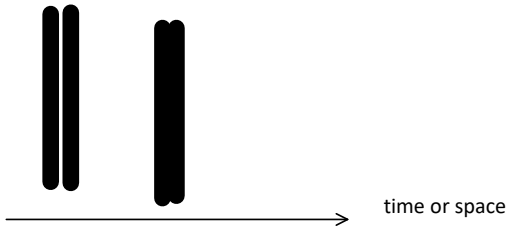
- Deliberate under/over: Camera will change one or more of the other three settings, with attendant side effects. With underexposures, get loss of detail in shadows. Worse, at high overexposure, lose detail in highlights.

Resolution

Any measurement requires 3 types of resolution: spatial, temporal, measurand (dynamic range)
Making an image is equivalent to making a measurement of light (measurand)

Resolution: Spatial

Can two adjacent things be resolved?

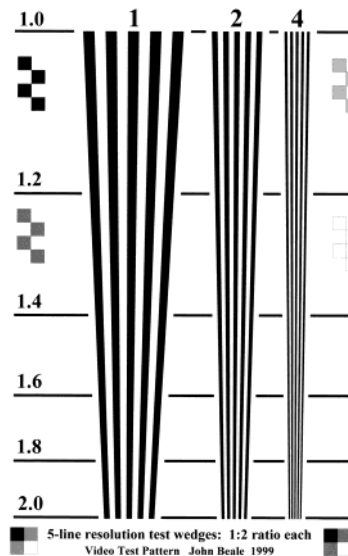
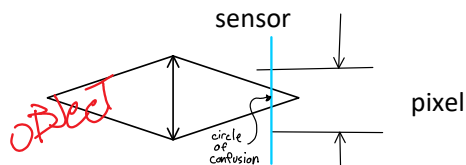


Resolution = minimum distance between two objects for them to be recognized as separate. Applies to objects (spatial resolution) and events (temporal or time resolution) and any quantity being measured (measurand)

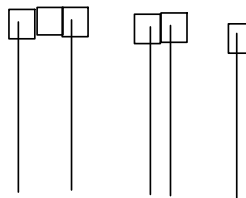
Spatial resolution can be DEGRADED by

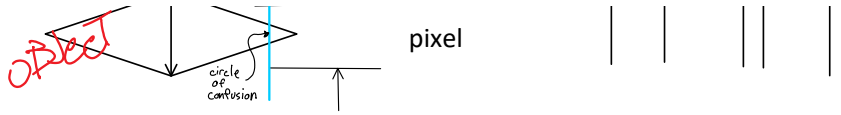
- Low contrast
- Compression artifact (in jpegs)
- ISO noise
- Bad focus
- Rastering, pixelation
- Diffraction effects
- Motion blur, interacts with time resolution

- **Bad focus: is circle of confusion > pixel?**



"Large resolution" = meaningless
"Fine resolution" or "Highly resolved"
= well - resolved.



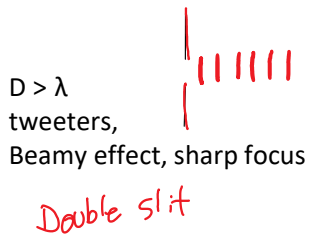


- Rastering, pixelation



<https://en.wikipedia.org/wiki/Pixelation>

- Diffraction effects if lens aperture or pixel size $< \lambda$ wavelength of light



$D < \lambda$
woofers, relatively
small aperture



Example: <https://luminous-landscape.com/understanding-lens-diffraction/>

Moral of the story: high f number has better depth of field, but sharpness can be defeated by diffraction effects.

