16.Resolution2

Friday, October 26, 2018 5:36 PM

Today:

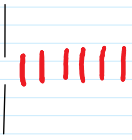
Finish resolution

Learning objectives: you will be able to analyze the spatial and temporal resolution of your images. You will be able to manipulate dynamic range of color channels in an editor.

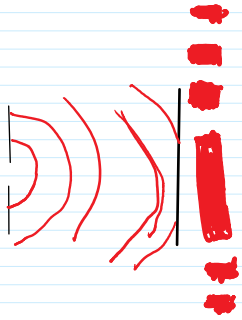
Team Second publish date: Oct 25 minus your team number.

- **Diffraction effects if lens aperture or pixel size < λ wavelength of light**

λ < d
tweeters,
Beamy effect, sharp focus



λ >d
woofers, relatively small aperture



fuzz from interference effects

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.

Current sensor sizes range 35 - 3 mm. For 3k px wide, 1 pixel = 10 -1 µm.
Red λ = 0.7 µm. Pretty close!

Homework results: F/ for best sharpness.

Best f/	Sensor size
10	DSLR
7.1	DSLR
6.3	DSLR
Around 8	Full frame
12	DSLR
3.5	Small camera
8	mirrorless

'Full Frame' DSLR: sensor size is ~35 mm
~ $1000
Often more MPx (35?), and larger sensor has less diffraction effects

For comparison:
Human eye resolution, 74 to >500 Mpx, depending on how you count.
http://www.clarkvision.com/articles/eye-resolution.html

How much resolution is needed?

Consider range of scales:

3000 px wide image, can see 1:1000 = 3 decades of scales

What is a decade? 10x; AKA order of magnitude O(x)

Largest scale = whole frame, takes 3000 px.

Smallest resolvable scale = feature that takes up 3 px or so.

3→30 One decade

30 → 300 2nd decade

300→3000 3rd decade.

We can resolve features that range across 3 decades of scales.

In flow, scales can be 3 minimum,

For turbulence need 4 or 5 decades minimum

Same scale considerations as for CFD (computational fluid dynamics, simulations of fluid flows):

If resolution is increased, is new information seen?

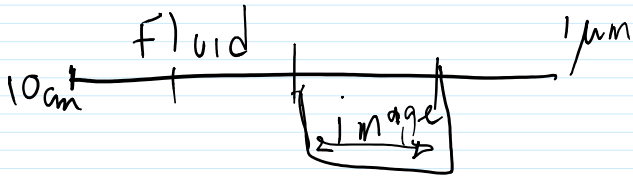
Is it important information?

In CFD, could have different physics; even large scale results could be wrong

In Flow Vis, missing small scales could lead to misinterpretation of physics

Minute paper: In your GW image, how many decades of length scale was in your **flow**?
Is there a sharp boundary in the flow that only takes up one or two pixels in the image?
Are all the scales of interest in the flow well-resolved in the **image**?
In other words, was your flow spatially resolved?

What was the major effect that degraded the resolution?
How to tell motion blur from bad focus:
sides of streak will be in focus.
Just being out of focus will be an overall blur.



Previous years

GW time/space resolved?	Reason why not
7 said yes 15 no	Pixelization Motion blur /// Hard to tell due to diffusion in subject Focus: limited DOF ////

	diffusion in subject Focus: limited DOF Chromatic aberration

Time resolution