

Welcome to CIVIL-510

“Quantitative Imaging for Civil Engineers”

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Lesson Three recap

Definitions

- ▶ Blur measured in px or mm from an edge
- ▶ Values of pixels not independent
- ▶ Noise measured with $SNR = \text{diff} / \text{std}$
- ▶ Noise affecting each pixel separately
- ▶ Basic filtering: noise can be reduced with some increase of blur

Today: hardware

We have 10 USB microscopes, and we're going to study their operation and use all the knowledge we've gained in the last lessons (including the confusing point about downscaling images).

We need to characterise these microscopes as well as possible to make measurements next lesson.

Objectives

- ▶ Total number of pixels?
- ▶ What's the image encoded in?
- ▶ Big or small aperture?
- ▶ Does this camera have a fixed focal plane?
- ▶ Measure pixel size ($\mu\text{m}/\text{px}$) at bottom
- ▶ Collect data set for “autofocus” algorithm
- ▶ Sharpness on grid in μm , and see how it changes with upscaling or downscaling
- ▶ SNR on grid with full illumination?
- ▶ SNR on grid with half illumination?
- ▶ What is the field of view in degrees?

Total number of pixels

Start from the beginning: find a way to save **images** (not video) from microscopes, and load it in **Fiji**.

How many pixels are the resulting images?

Image format?

How are the pixels encoded? What does this tell us about the camera?

Exposure time? Sensitivity?

What is the camera doing!?

Aperture

Does it feel like we have a big or small aperture? How can you tell?

Fixed focal plane?

Do we have a fixed optics and we're just moving the camera?

How to falsify this claim?

Dark field image

Do your best to take a dark field, in Fiji convert it to 8 bit (greyscale) with [Image] → [Type] → [8-bit]

All zero? Spread? Constant in time?

Pixel size

Pixel size is measured in $\mu\text{m}/\text{px}$ (or mm/px). What would you guess?

Please measure it with the microscope *touching a surface*.

Data collection 1: focus

Please collect a **series of at least 7** images, starting out of focus, getting into focus and out of focus again, on a sharp edge.

Please draw **Image number** vs **Sharpness (px)**

Analyse your sharpest image

Compute (convert) your sharpness from **px** into **mm**.

Compute sharpnesses (in mm, does the pixel size change?) for these scales:

[Image] $\rightarrow$ [Scale]

- ▶ x4 upscale:
- ▶ x2 upscale:
- ▶ original size:
- ▶ x2 downscale:
- ▶ x4 downscale:

Please compute SNR on grid

Full illumination, use black for STD.

$$\text{SNR} = \frac{\text{contrast}}{\text{STD}} = \frac{\mu_{fg} - \mu_{bg}}{\sigma_{bg}}$$

Is this an overestimation or underestimation?

Recompute with half illumination

Do you expect increase or decrease?

FOV – field of view

How to compute this? We don't know where the camera is...