Welcome to CIVIL-510
"Quantitative Imaging for Civil Engineers"

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Lecture Five: 2024-10-08

Lesson Four recap

Definitions

- Dark field image $\neq 0$
- Saw a very small depth of field
- Measured two pixel sizes
- Mostly managed to see the decrease of 10-90 rise distance with focussing

What you should understand

Page 1: Hardware description

- Darkfield
- Pixel size (μm)
- Note about focussing
- Sharpness (μm) and sharpness with x2 up and downscale
- SNR estimation (today)
- 1 bonus interesting image *each!*

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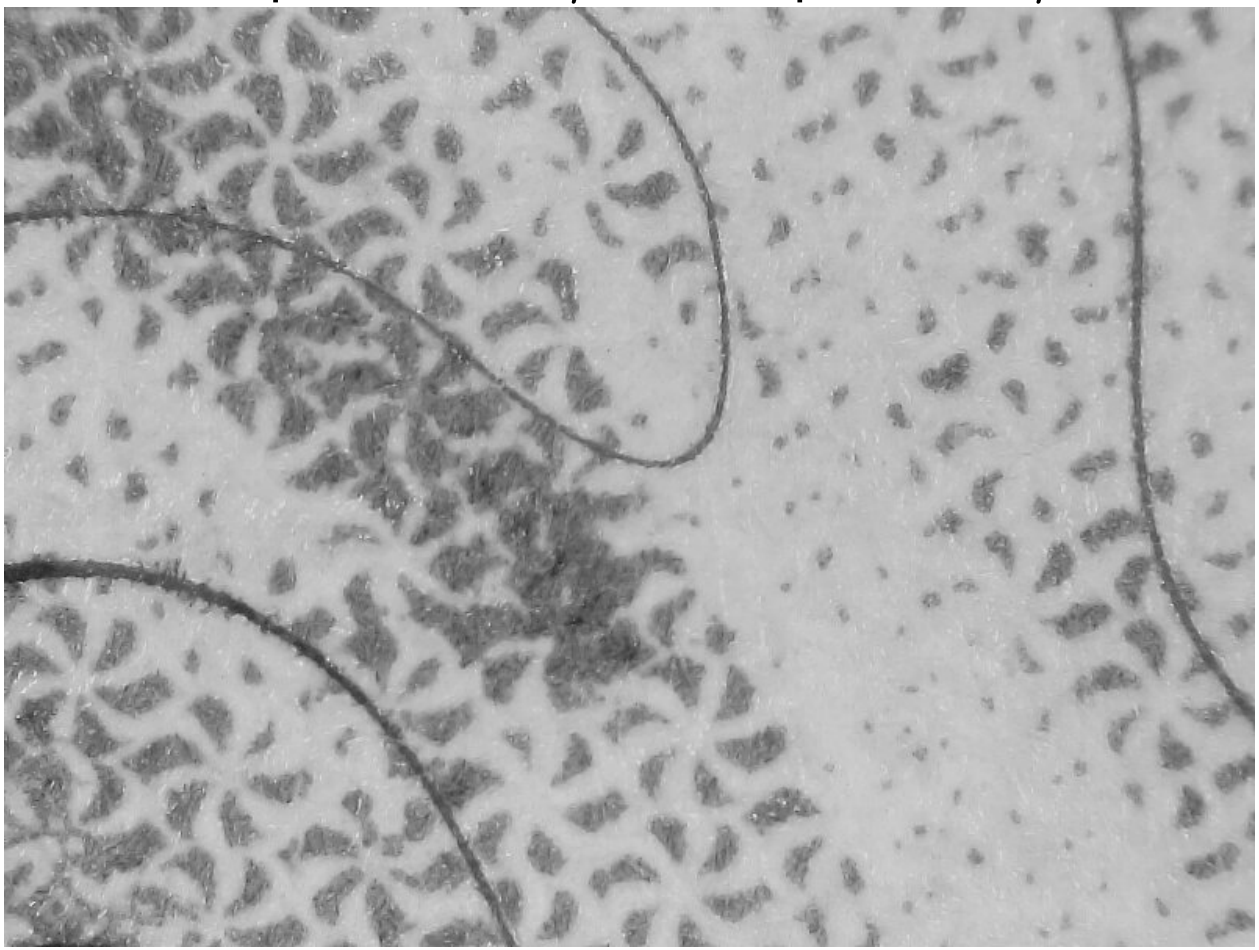
Page 2: Today's measurements

- Image acquisition difficulties
- Object identification
- Object characterisation
- Histogram (min 16 objects) of object "size"
- Histogram (min 16 objects) of object "shape"
- Discussion about errors and limitations

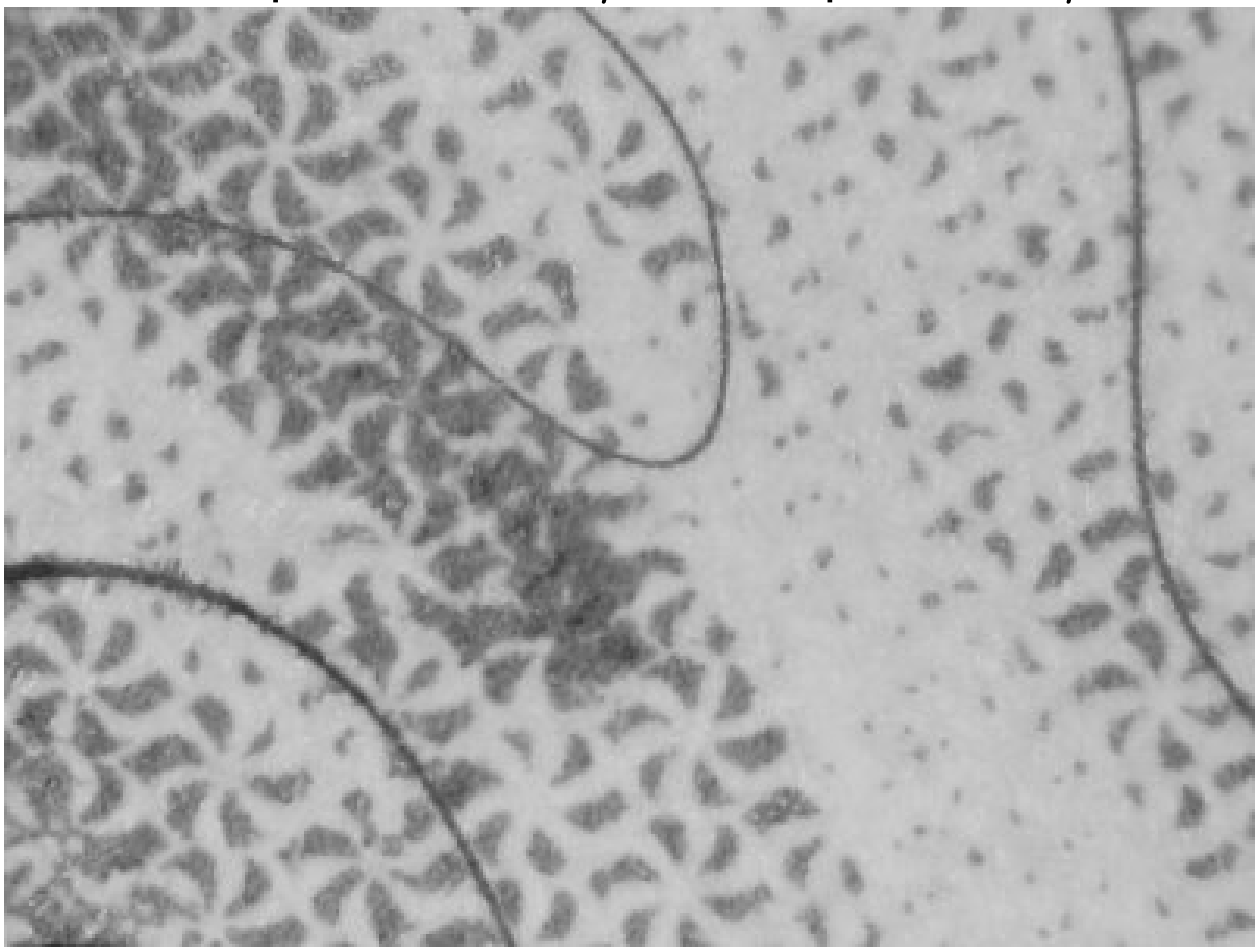
Small summary about resolution and downscaling

800×600, pixel size=7μm, sharpness=14μm



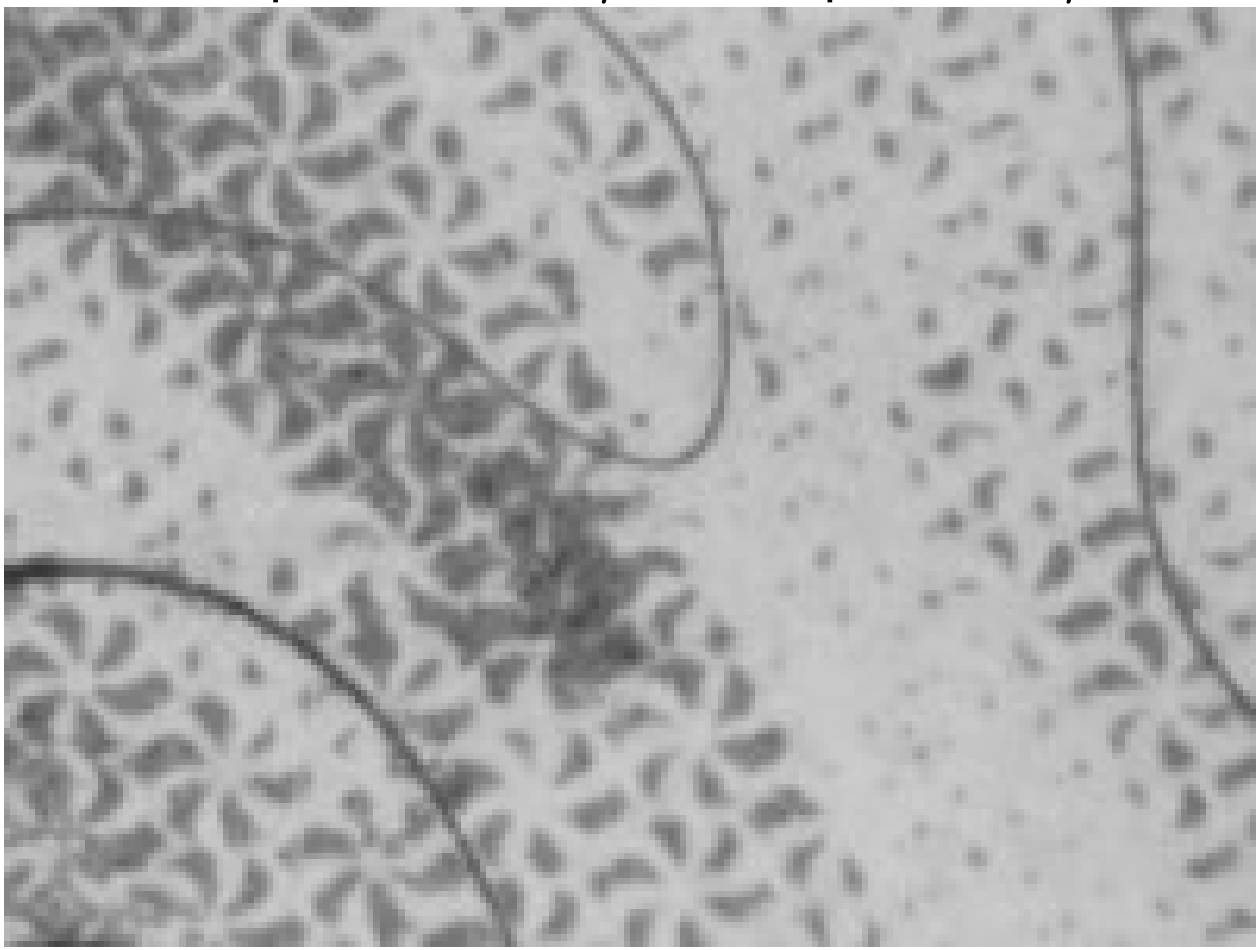
Small summary about resolution and downscaling

400×300, pixel size=14μm, sharpness=28μm



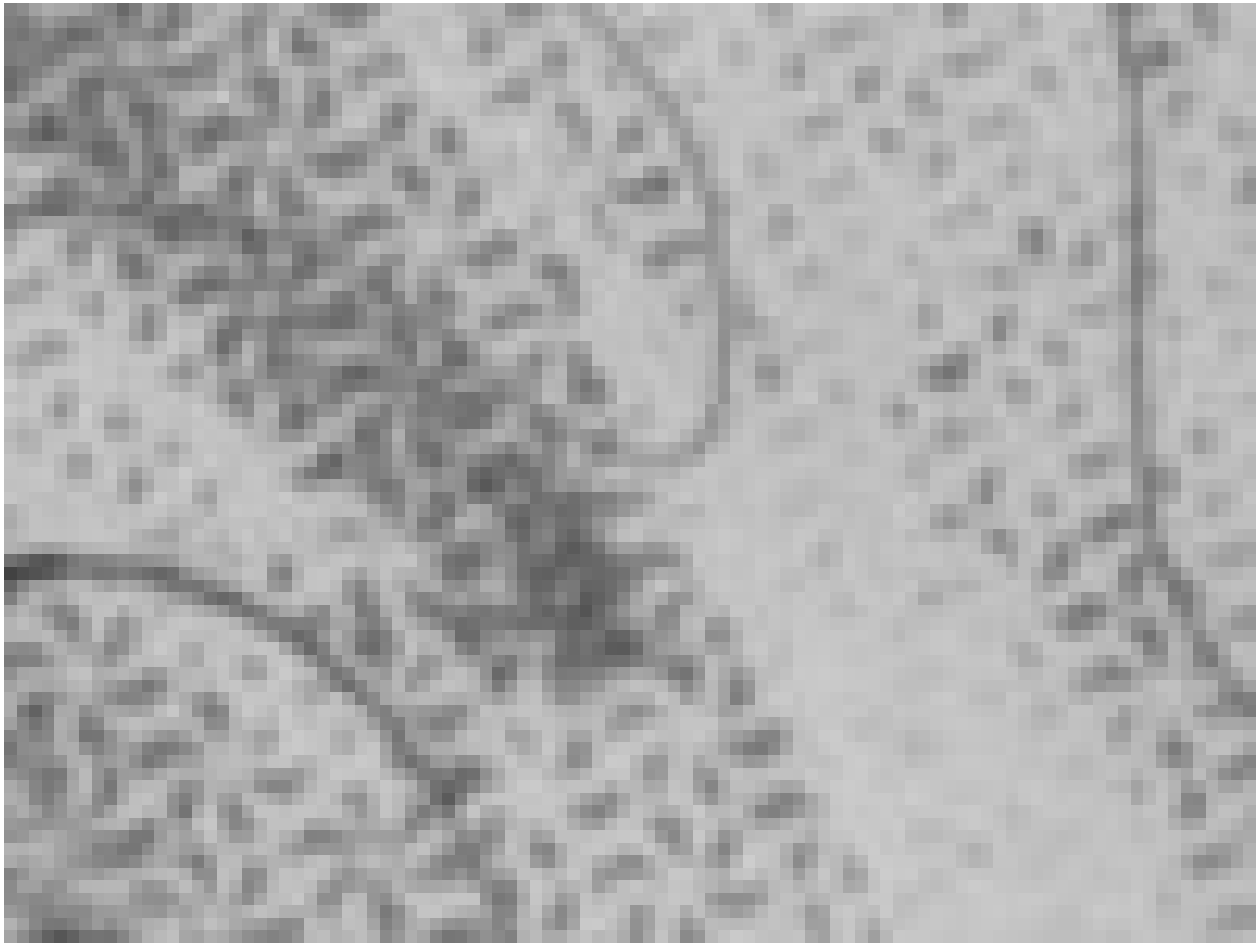
Small summary about resolution and downscaling

200×150, pixel size=28μm, sharpness=56μm



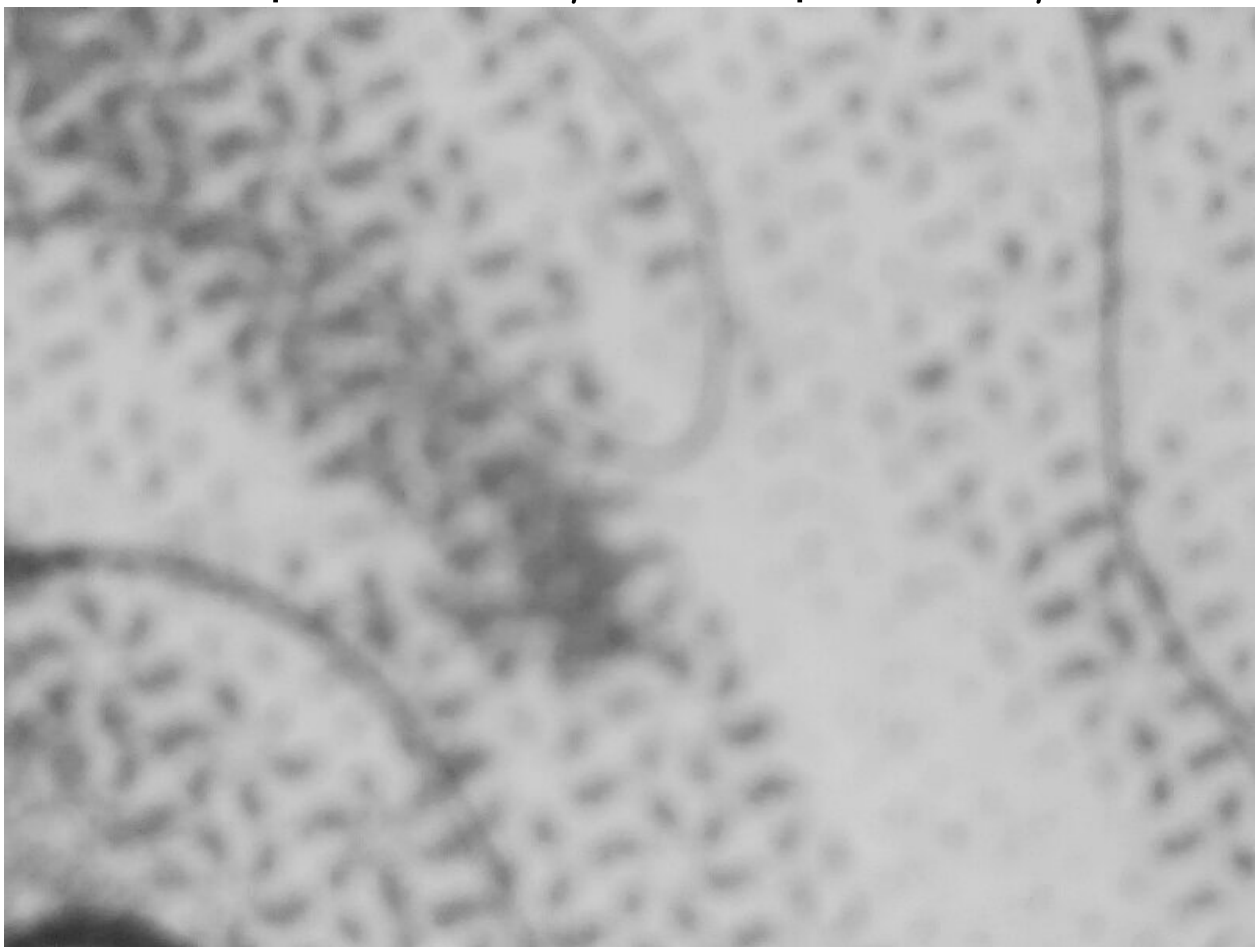
Small summary about resolution and downscaling

100×75, pixel size=56μm, sharpness=112μm



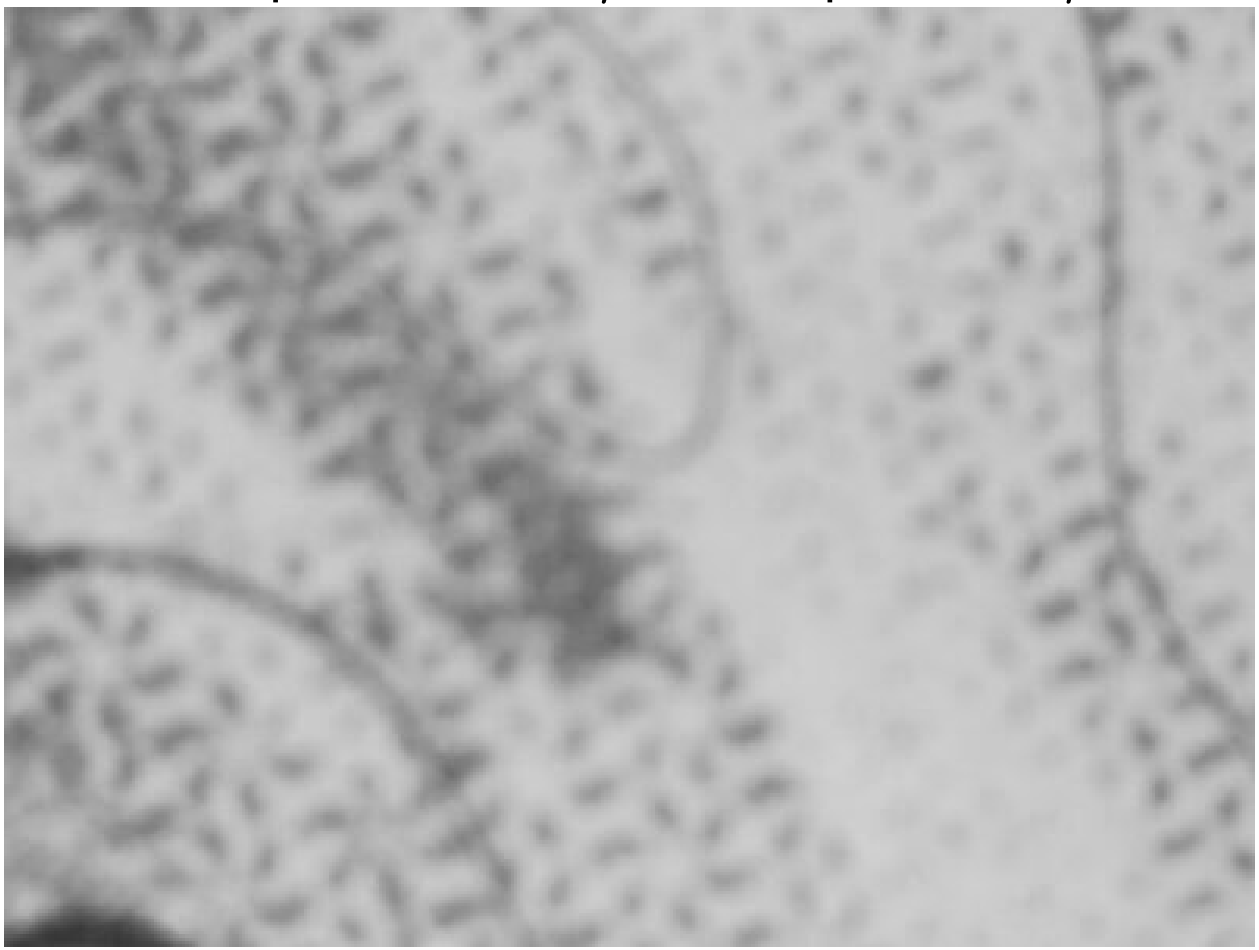
Small summary about resolution and downscaling

800×600, pixel size=7μm, sharpness=91μm



Small summary about resolution and downscaling

400×300, pixel size=14μm, sharpness=84μm



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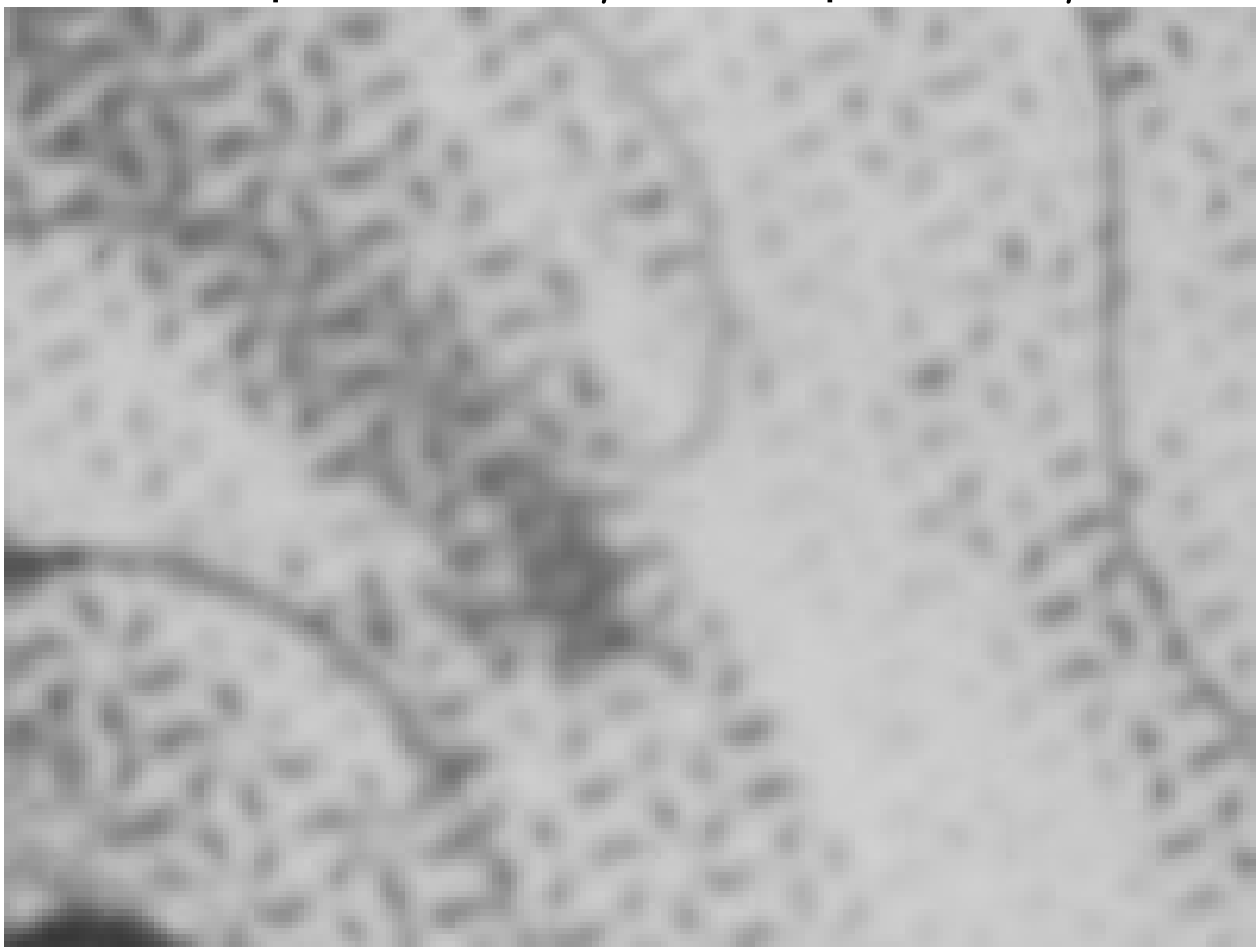
200×150, pixel size=28μm, sharpness=84μm



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Today: Measuring objects

Image analysis

We're finally going to measure something from our images!

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Image analysis

We're finally going to measure something from our images!

I have 2 different types of sand, whose particles I would like you to characterise

Let's try too look at some particles and measure the SNR

Then I'll give a little lecture about object characterisation

To your microscopes

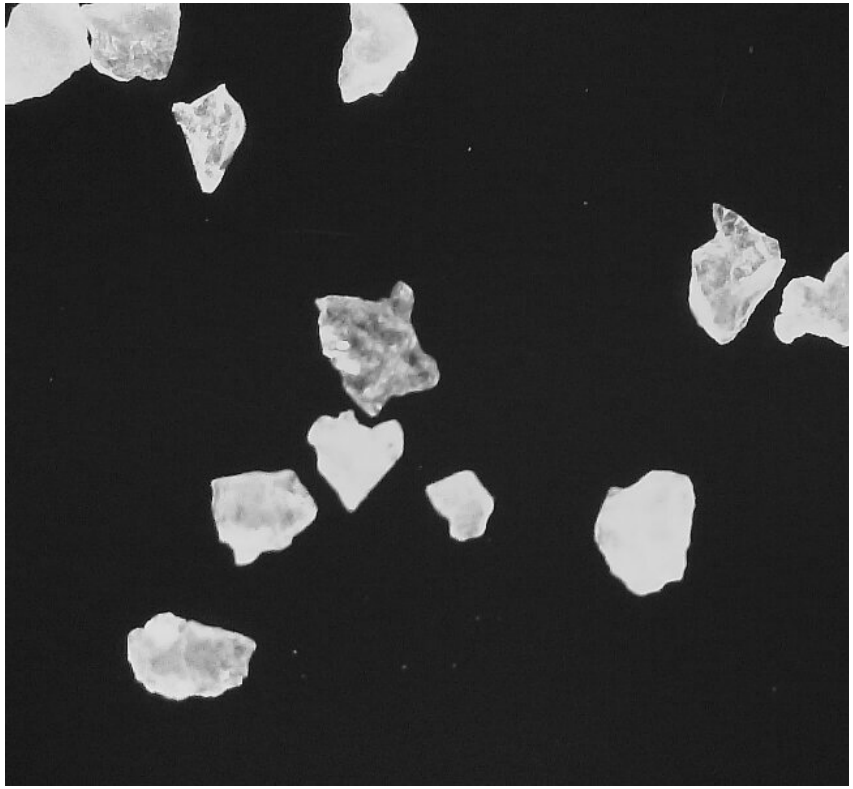
Try to get a good picture of your particles. Careful about illumination

To your microscopes

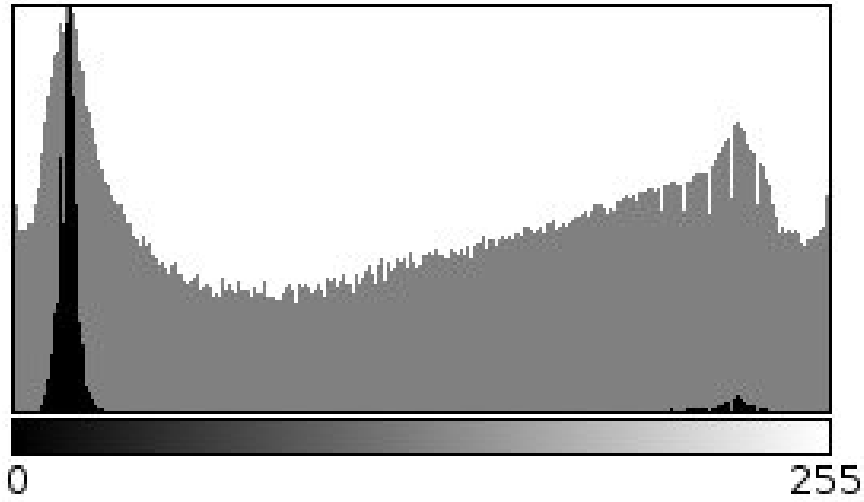
Try to get a good picture of your particles. Careful about illumination SNR reminder: $SNR = \frac{GV_{\text{high}} - GV_{\text{low}}}{STD_{\text{background}}}$

Image histogram

Greyscale Image



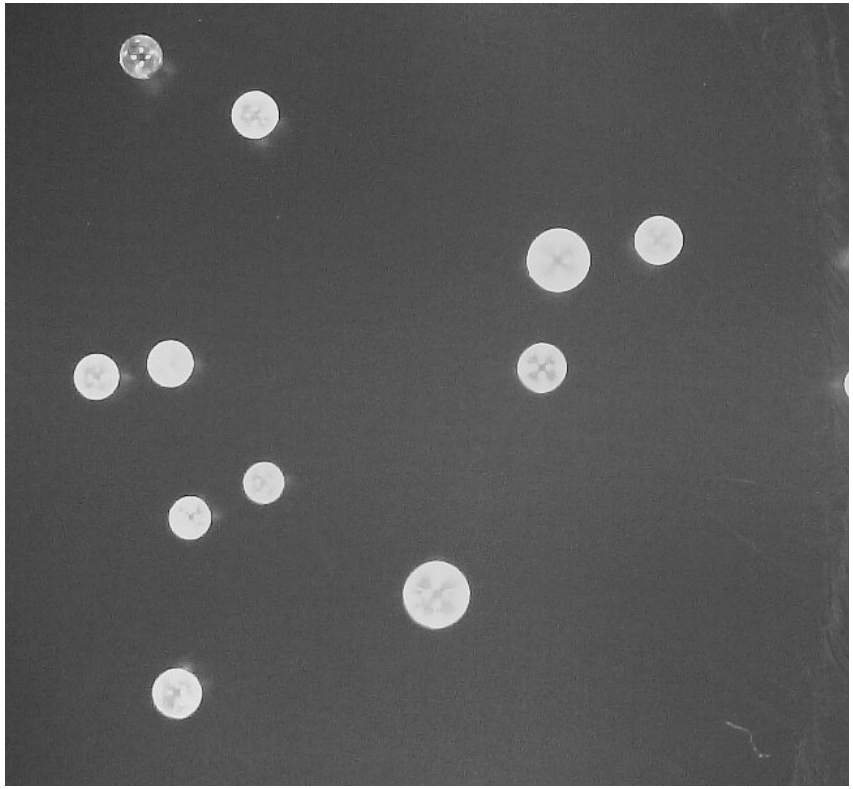
Histogram – log(value) in grey



N: 480000	Min: 0
Mean: 38.596	Max: 255
StdDev: 62.061	Mode: 17 (72901)
Value: 119	Count: 54

Image histogram

Greyscale Image



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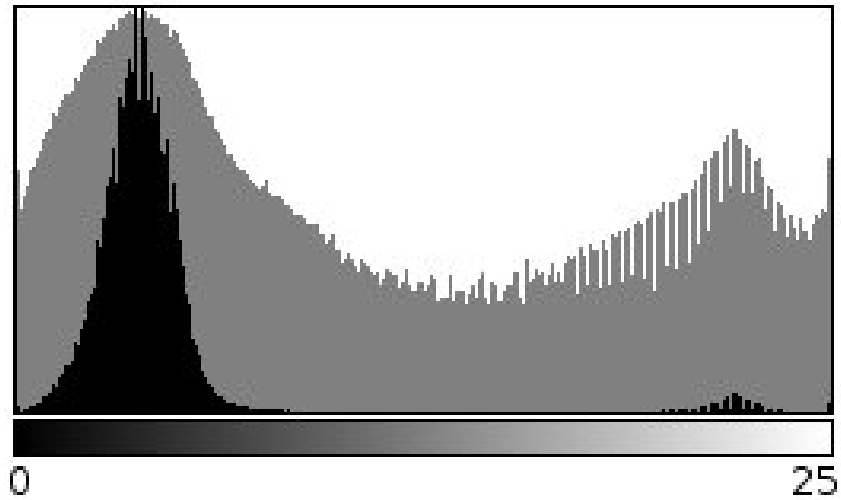

N: 480000	Min: 0
Mean: 44.922	Max: 255
StdDev: 36.789	Mode: 39 (19665)
Value: 15	Count: 2316

Thresholding

Binary classification of pixels.

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Binary classification of pixels. Otsu's method is a good statistical way to set a threshold to "minimise the intra-class variance" (or maximising the inter-class variance).
Let's see how it works.

What can we do with this binary image?

This is a completely new idea, and a completely new image.

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What about SNR?
What about Sharpness?

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What is easy to calculate in this image now?

What can we do with this binary image?

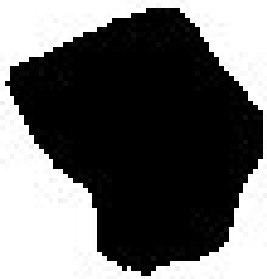
This is a completely new idea, and a completely new image.

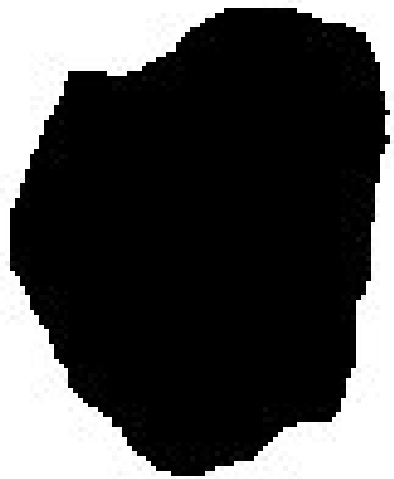
What about SNR?
What about Sharpness?

What is easy to calculate in this image now?
Think about what you could calculate with matlab

Some morphological operations

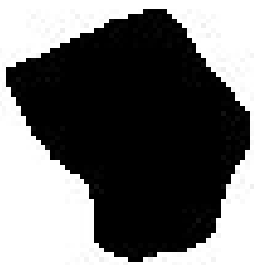
Original

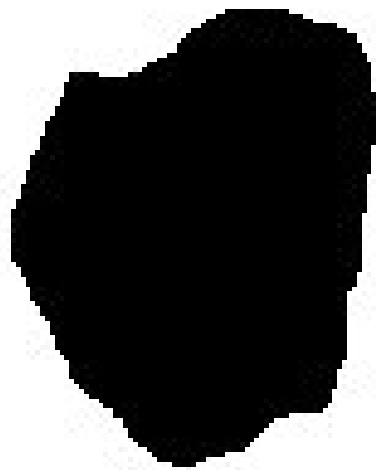




Some morphological operations

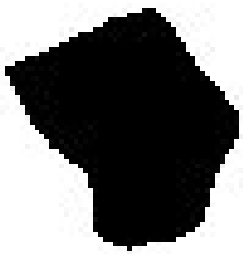
Erosion x1

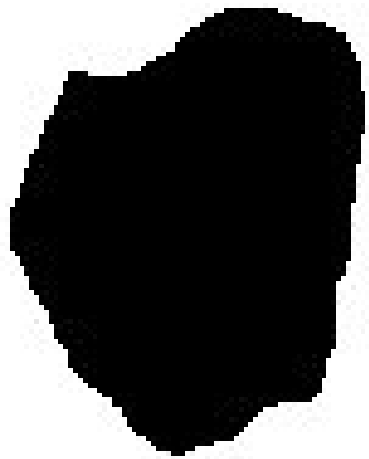




Some morphological operations

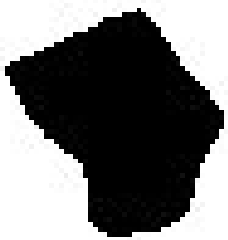
Erosion x2





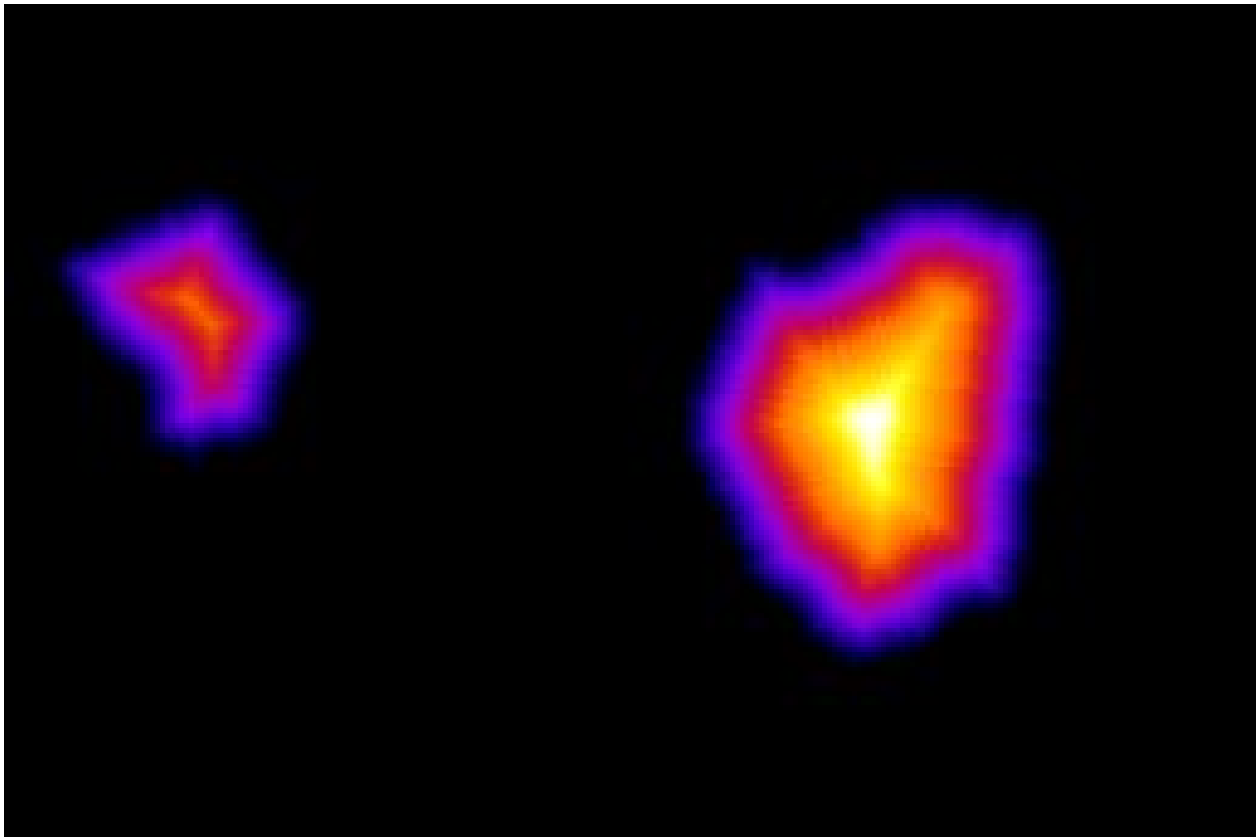
Some morphological operations

Erosion x3



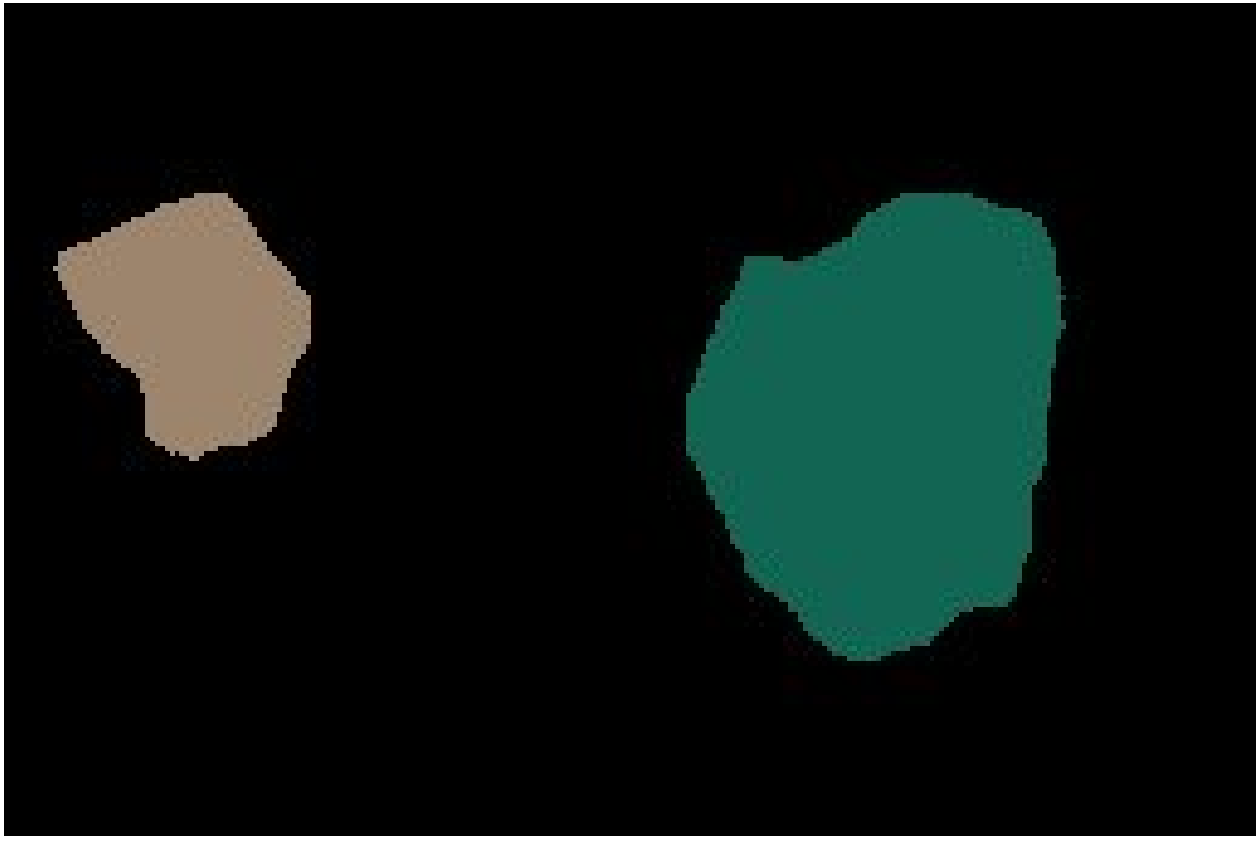
Some morphological operations

Distance transform



Some morphological operations

Labelled



Thinking caps on

1. I'd like a measurement in μm of a representative size of each particle

2. I'd like a measurement of roundness (normalised?) of each particle