Alert School:
Discrete Mechanics of Geomaterials

Experimental Sessions 1

2D

Geomechanics

- Continuum Models
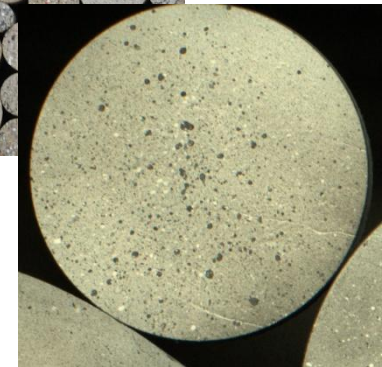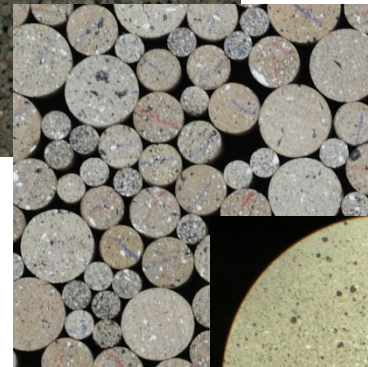
- Discrete Models – (mostly numeric)

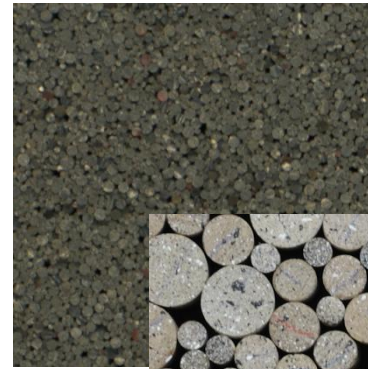# Some Experiments in $1\gamma 2\varepsilon$

- 3 Different Scales of Materials:

    – Small – Continuum?

    – Middle – Continuum???

    – Large – Not continuum

Videos…

Some Experiments in 1γ2ε

- 3 Different Scales of Materials:

  – Small – Continuum?

  – Middle – Continuum???

  – Large – Not continuum

2D Experimental Measurements

- Photos

- What is a photo? A matrix of values.
- How does a computer store values?
  - Integers {8, 16, 32}
  - Floats { 32 bit }

OK, let's have a go ourselves

Loading Images

- Matrix of Values
- Look at X and Y positions

- Load second image
- Get two 2D images into stack
- Estimate displacement in 2D of a grain

Measurements?

- Depending on scale we can do either:
  - Continuum (DIC)
  - Discrete (DIC or Particle Tracking)

DIC

- Basically pattern matching…

- Compare window size to image

DIC

- Image Correlation
  - Displacement (in pixels X and Y in image)
  - Gives Strain in 2D
- Speed & Quality = f(Important Variables):
  - CCD, Illumination, Optics
  - Search Range
  - Window Size
  - Number of nodes

Half Time

- Swap with Computer partner

DIC

- It takes time… so:
  - First pass:
    - To find right search window…
    - Large node spacing to go fast
  - Second pass:
    - Once search window is correct
    - More precise measurement

DICing them

- Copy both images into DIC/input
- Check settings.txt:
  - `SearchWindow_X_Positive=6`
  - `SearchWindow_X_Negative=6`
  - `SearchWindow_Y_Positive=6`
  - `SearchWindow_Y_Negative=0`

  - `NodeSpacingX=100`
  - `NodeSpacingY=100`

  - `CorrelationWindowSizeX=20`
  - `CorrelationWindowSizeY=20`
- Run DIC wait for:
  - `*** OK, Finished! ***`

First Pass

- Load Results – what can we see?
  - `Output RAW image: 39 x 59`
  - Take these values and put them into Fiji
    - File ➜ Import RAW
    - DIC/results/xxx-X.b32
    - Width = second number (59)
    - Depth = first number (39)

Question:

- Is the search range OK? Smooth Results?

- LUT + explanation
- Brightness and Contrast (displaying the values that interest us)
- Histogram for statistics

If Search range is OK

- Reduce Node Spacing for a finer field
  - From 100px to 25px

- Run the DIC

- Let's look at:
  - Strain XX, YY and Invariants (EV, MxS)

Let's correlate the other images

- Medium Grains:
  - First Pass
    - remember: node spacing 100px
    - Check with X and Y displacements that the search window is correct
  - Second Pass
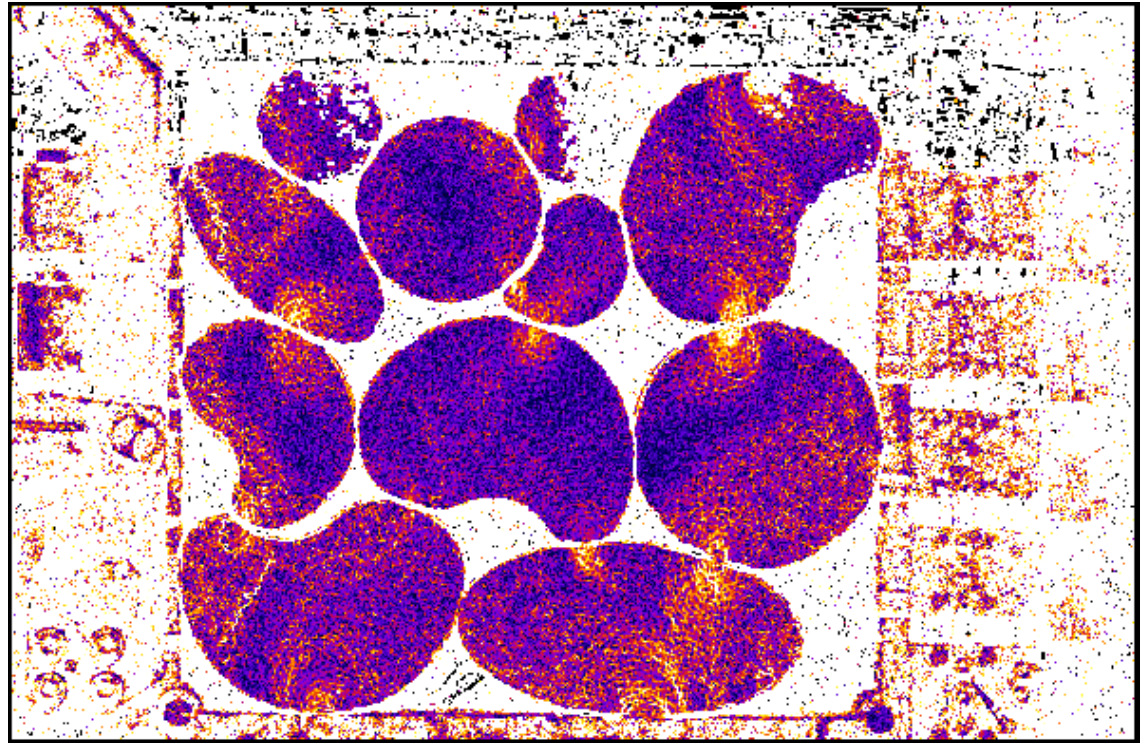   - Node spacing 20px
  - ➔ Shear Strain – Continuum?!
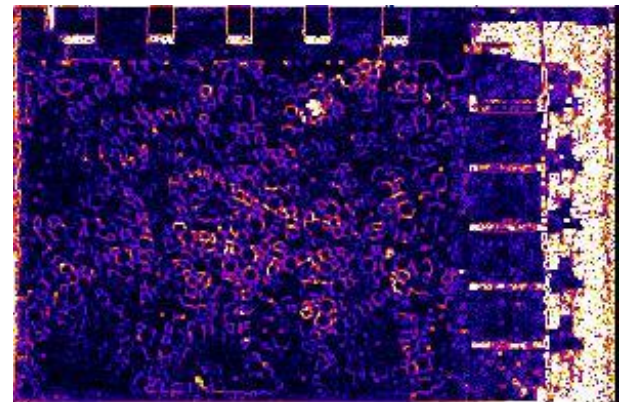
Particle Tracking

- Let's have a look how we could just follow grains...

- Binarisation into grain and not grain

- Splitting Grains apart

- Measuring Grains...

Let's correlate the other images

- Large Grains:
  - Same… first pass with 100px node spacing…
  - Use CC to clean up image

3D next time…

- All the same with another dimension in space!