IMAGE ANALYSIS FOR MATERIAL SCIENCE

From image properties to material properties (I)

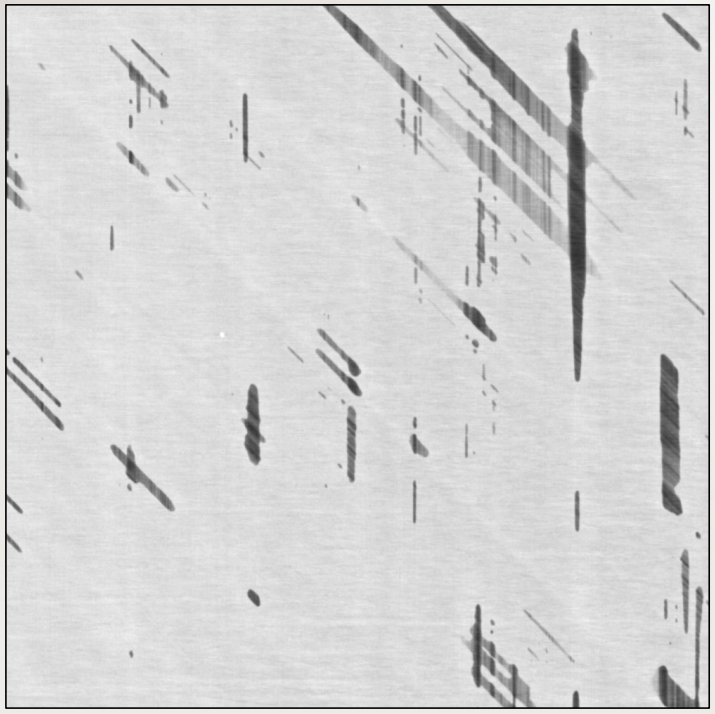
Key ideas

- Motivation
- General procedure
- Technical details
- Small Example
- Limitations
- Big example with Github and Federico's code. Resources at Imdea.

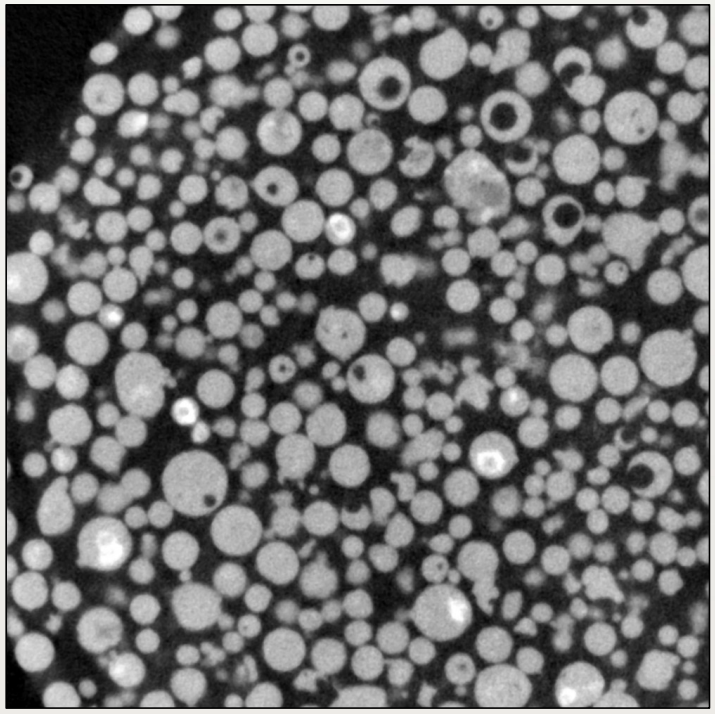
Motivation

How to analyze the microstructure of the materials from the images of our tests?

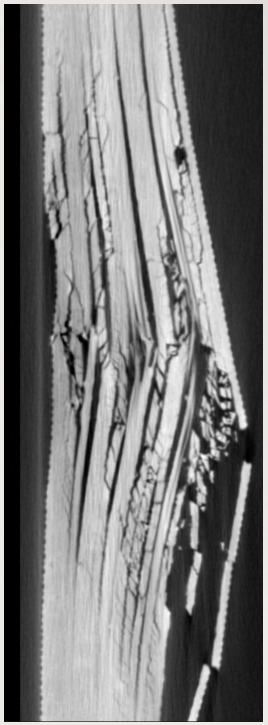
Porosity in CFRP tomography



Metalic Powder particles



Impact CFRP



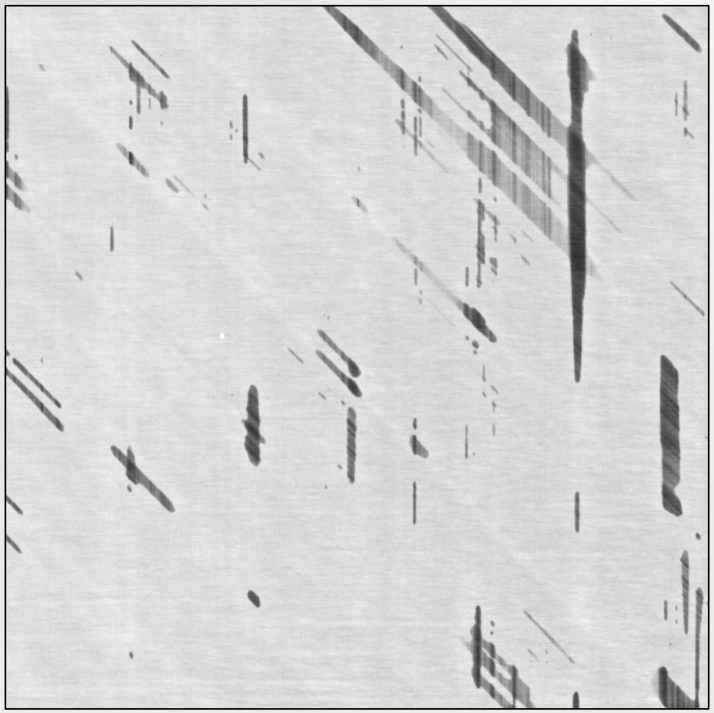
General procedure

1. Obtain a binary image.
2. Detect independent regions of interests.
3. Compute properties to the regions.
4. Relate the measured properties with functional aspects.

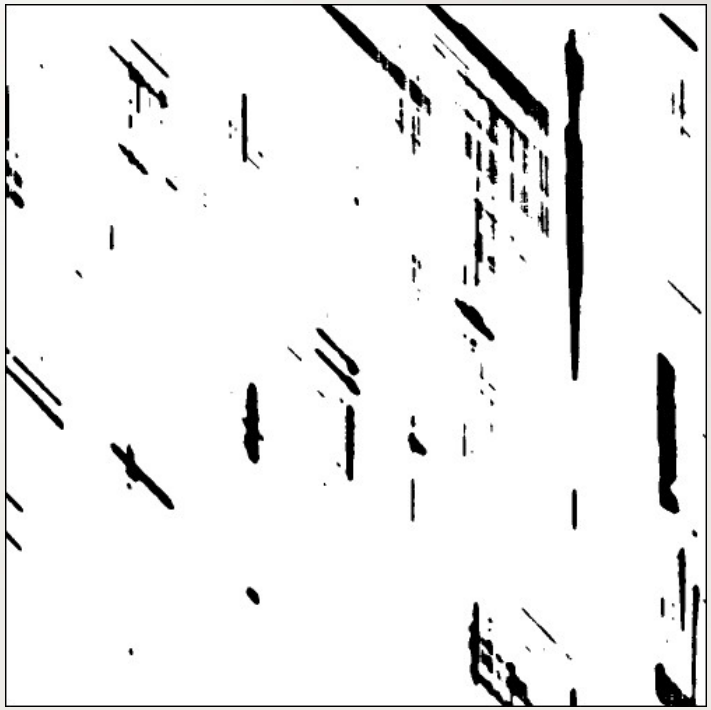
General procedure

1. Obtain a binary image.

Gray scale. Pixel values =(0 - 255/65535)



Binary. Pixel values =(0 background
1 regions)

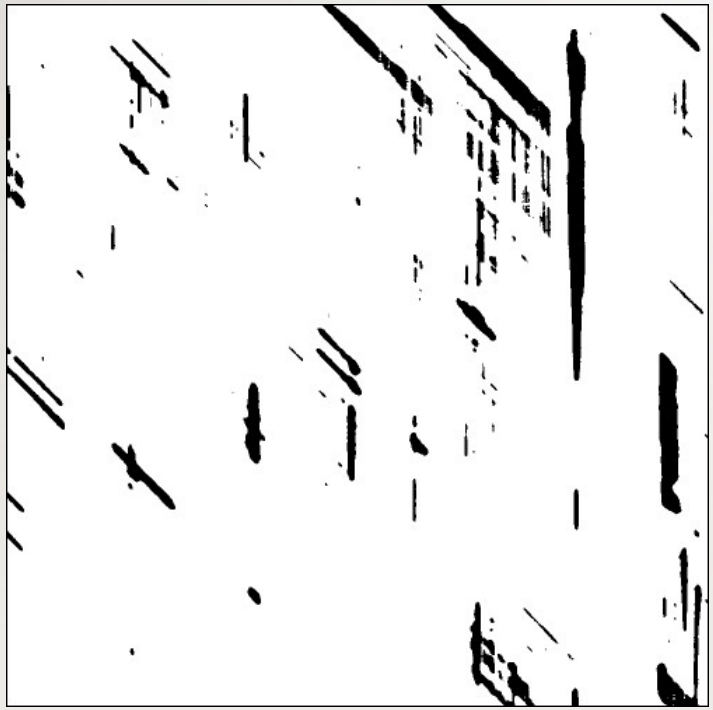


Avoid the term "black and white image" because it is ambiguous when google for questions.

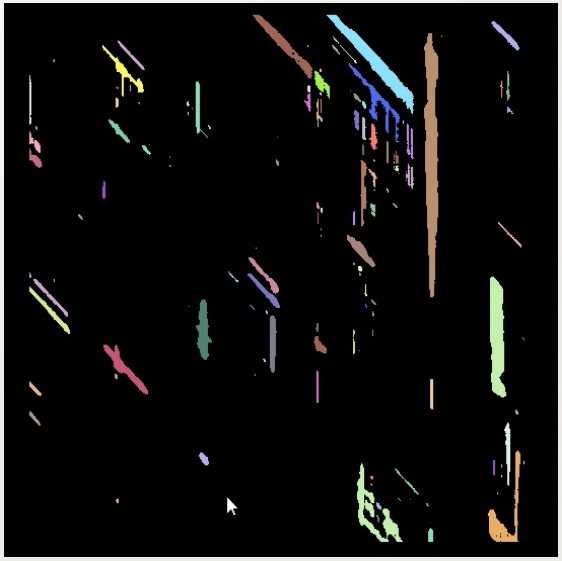
General procedure

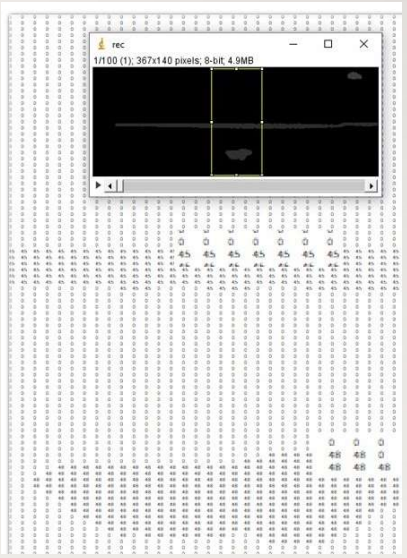
1. Obtain a binary image.
2. Detect independent regions of interests. Numbered ID for each region.

Binary. Pixel values =(0 - 1)



Labels. Gray levels. Pixel values = (0 background
1 region number 1
2 region… 2
n regions)

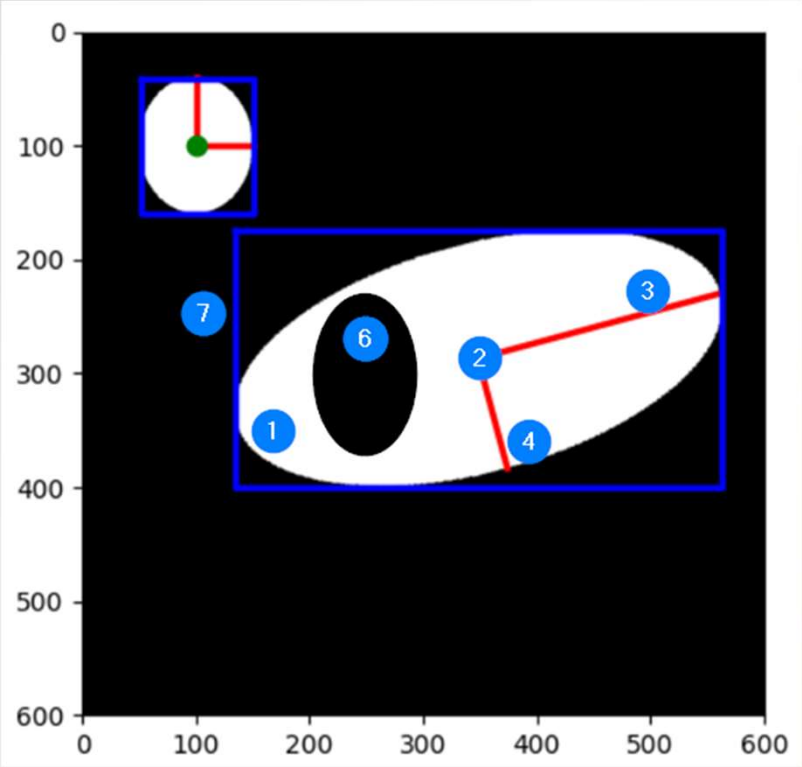




Avoid the term "black and white image" because it is ambiguous when google for questions.

General procedure

1. Obtain a binary image.
2. Detect independent regions of interests. Numbered ID for each region.
3. Compute properties of each region.



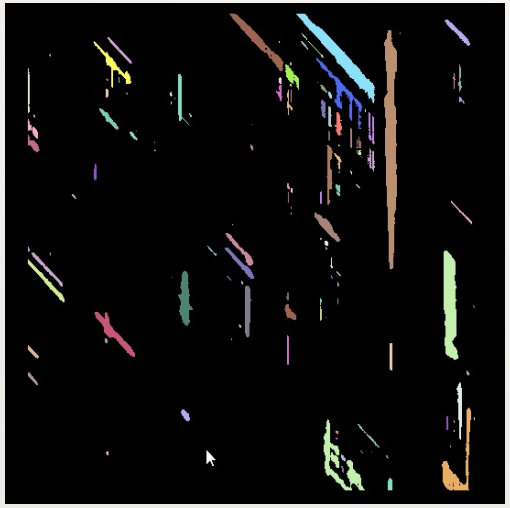
Common useful properties:

1. Area
2. Centroid
3. Long axis
4. Short axis
5. Coordinates of the region pixels.
6. Filled area
7. Bounding box

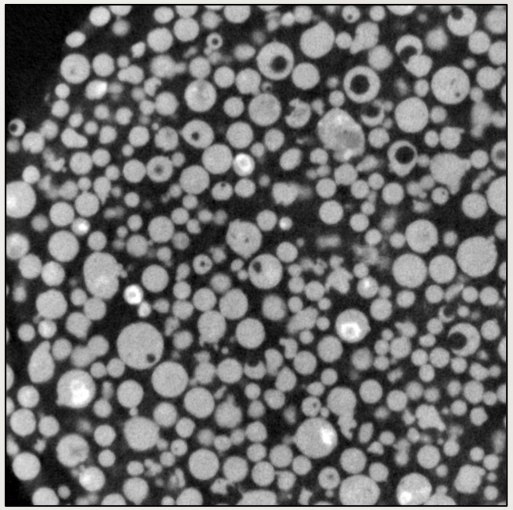
General procedure

1. Obtain a binary image.
2. Detect independent regions of interests. Numbered ID for each region.
3. Compute properties of each region.
4. Relate with material properties

Examples:



Manufacturing process with the area and the long and short axis of pores



Filled area of the particles with quality of final product

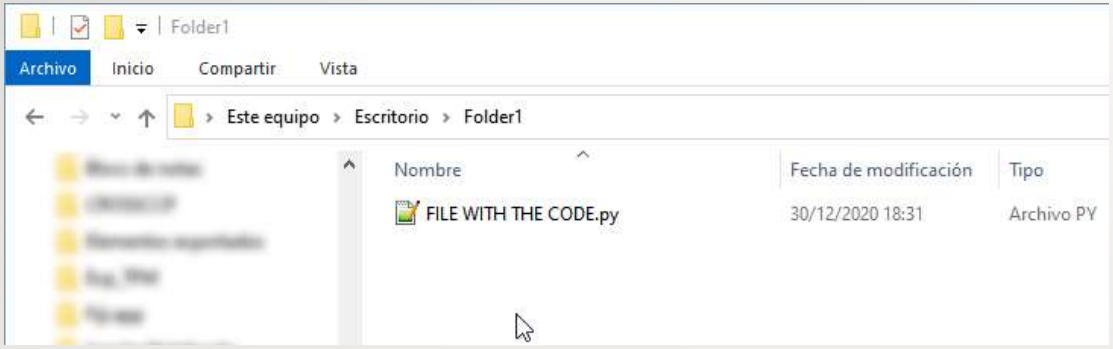
Technical details of the process

1. Absolute/ Relative paths
2. Image bit type.
3. Image formats. Raw and tiff.
4. Multichannel (RGB) or one channel.

Technical details of the process

1. Absolute/ Relative paths

Example:



Absolute path:
"C:\Users\Juan Ignacio\Desktop\Folder1"

Relative path:
"\Folder1"

The reference is where the running file is located

Technical details of the process

1. Image bit type

8 bit

- Unsigned raster: 0 - 255
- Signed raster: -128 a 127.

16 bit

- Unsigned raster: 0 - 65535
- Signed raster: -32767 - 32767.

Beware with the labels image when using 8-bit images, they only support 255 different regions

Technical details of the process

1. Image formats. Raw and tiff.

- **Raw** contains minimally processed data from the image sensor. → No information of the size of the images, nor bit type, little endian….

  A pain in the neck when coding

- **Tiff** contains all the information to open an image. → Most tiff readers do not admit images larger than 4 GB. (common in tomography)

Solution? Divide and conquer. Save the volume image as a collection of frame tiff images