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VISUAL INSPECTION OF MOTORCYCLE CONNECTING RODS

PROJECT WORK IPCV

Problem description

1 IMAGE CHARACTERISTICS

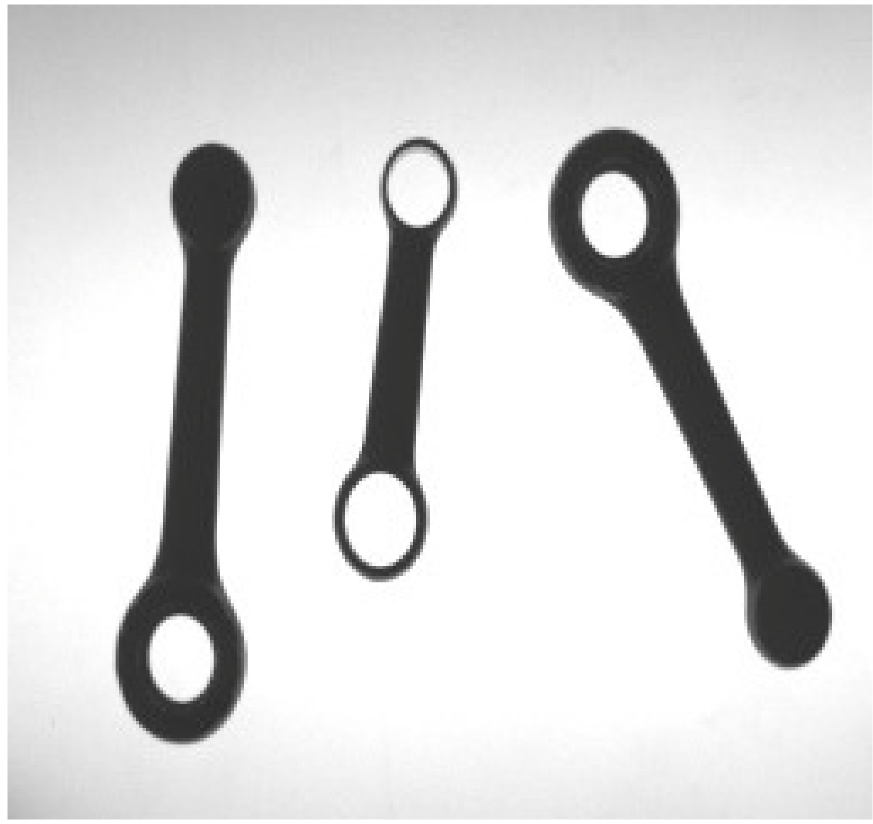
- Images contain only connecting rods.
- Connecting rods are well separeted.
- Images have been taken by the backlighting technique.

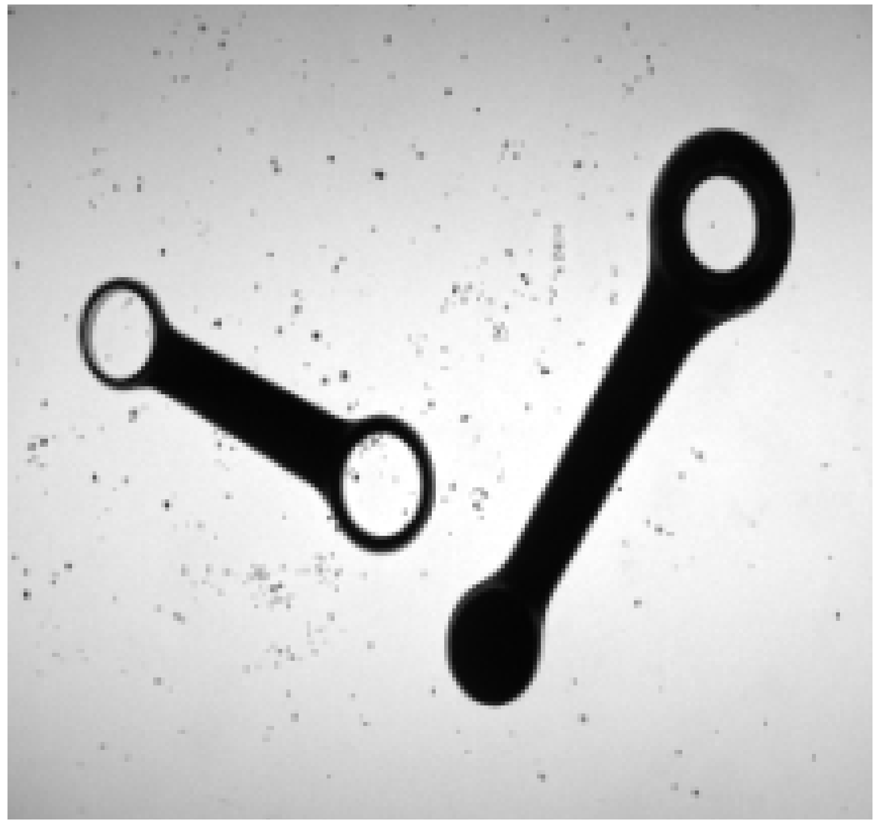
2 FIRST TASK

- Type of rod (A or B).
- Position and orientation (modulo π).
- Length (L), Width (W), Width at the barycenter (WB).
- For each hole, position of the centre and diameter size.

3 SECOND TASK

- The inspection area may be dirty due to the presence of scattered iron powder.

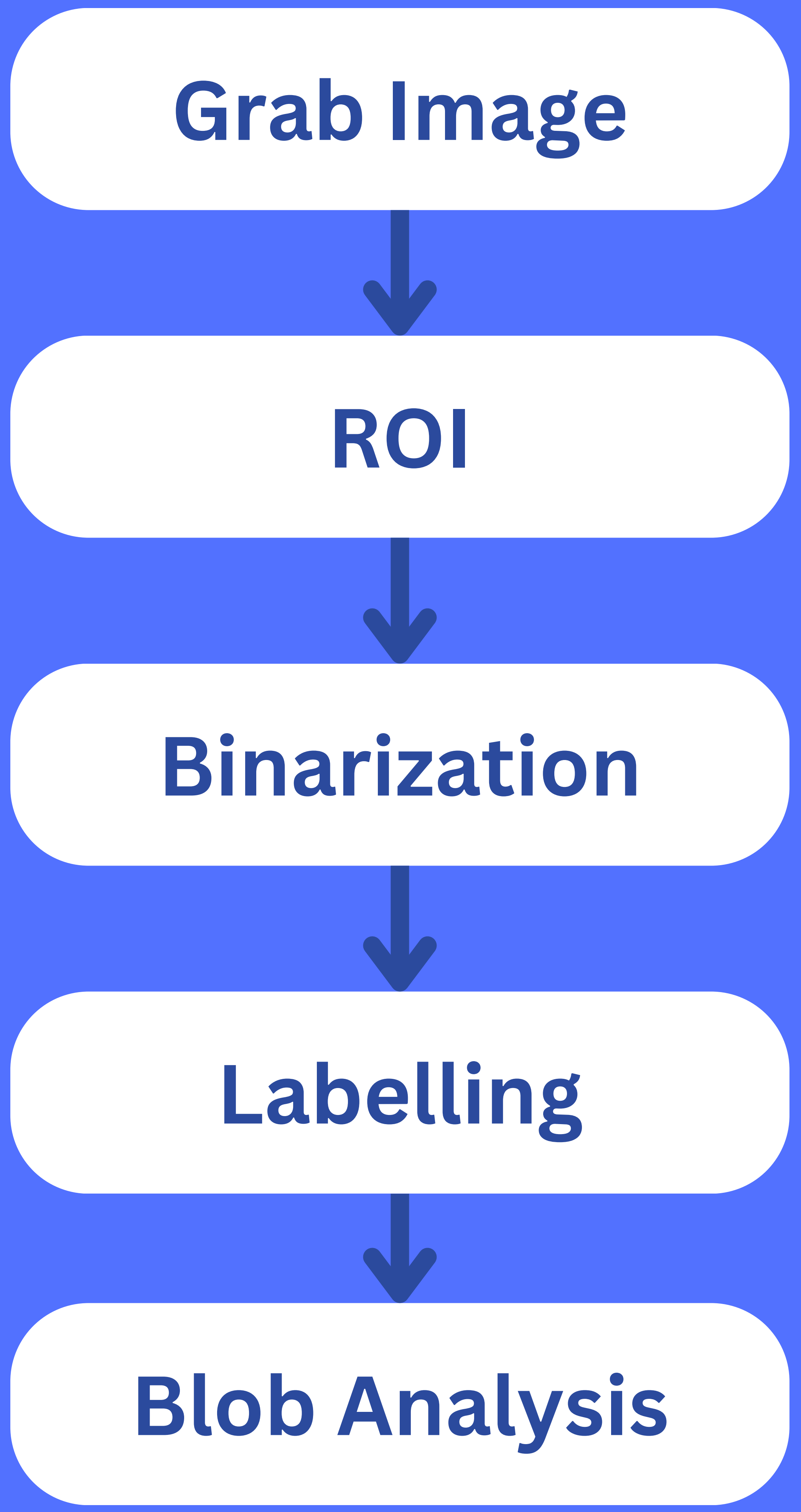




BLOB ANALYSIS PIPELINE

The first two steps are straightforward:

- The image is already acquired.
- The whole image is the ROI.



Grab Image

ROI

Binarization

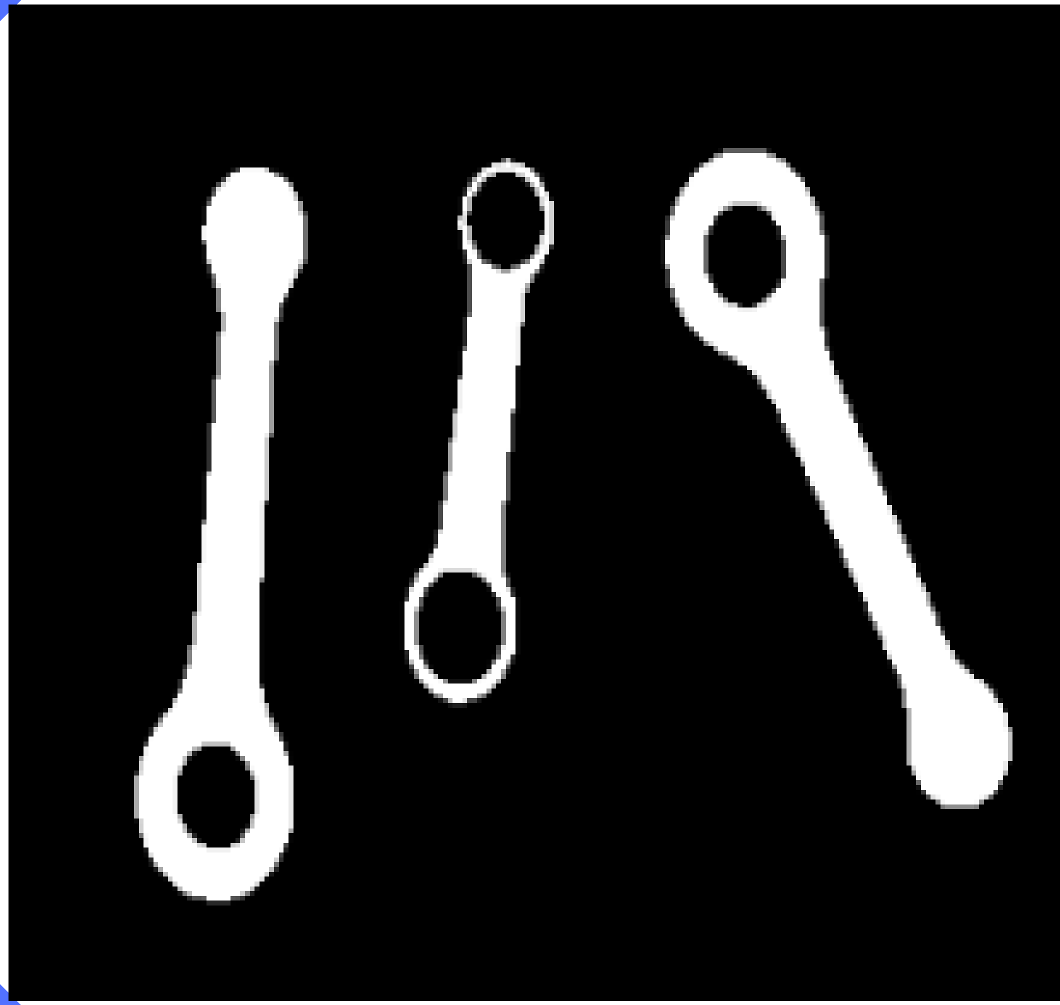
Labelling

Blob Analysis

BINARIZATION

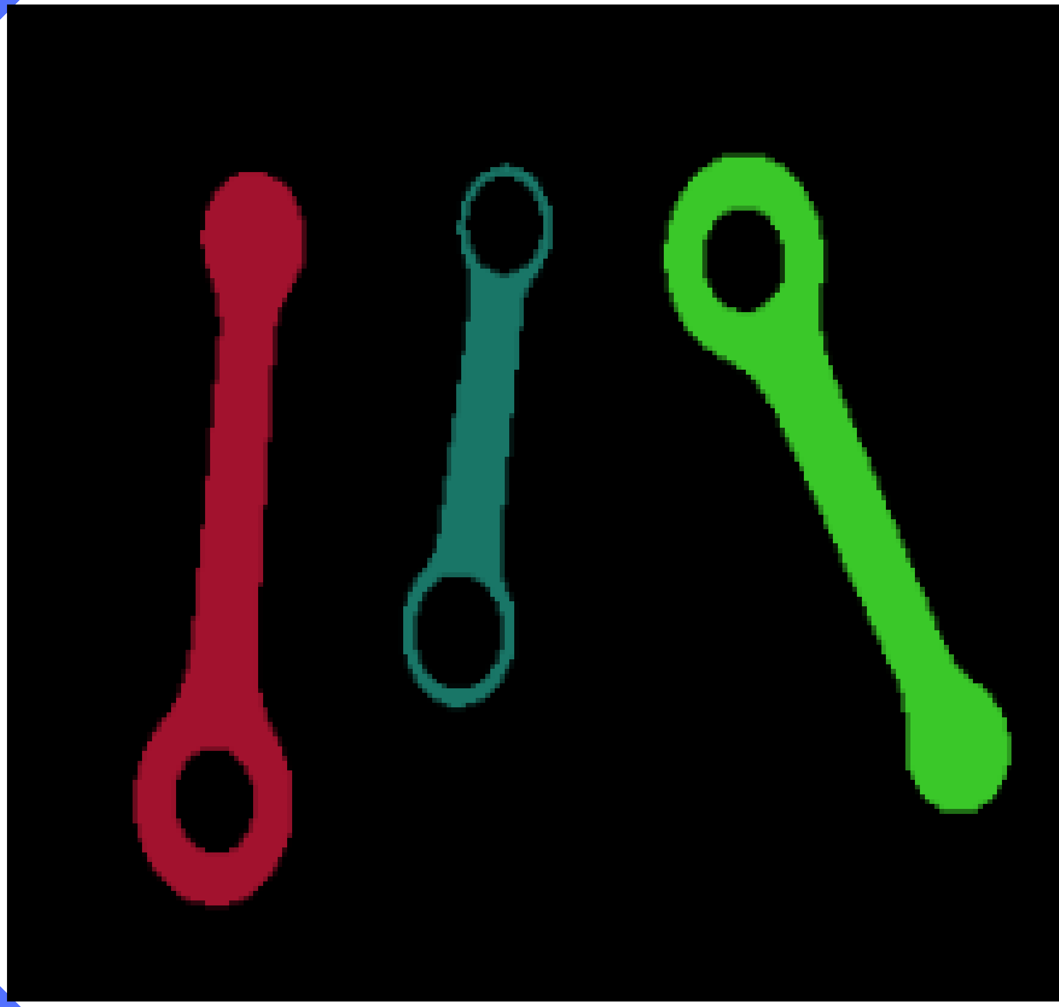
After different trials it has been chosen the Otsu's algorithm to achieve the best segmentation between foreground and background.

Thanks to this algorithm the binarization procedure is also invariant with repect to small changes in lightning conditions.



LABELLING

In the image, different labelled blobs carry different colors.



The ***connectedComponentsWithStats()*** function of OpenCV returns:

- the number of connected components
- the labelled image
- Some statistics
- The coordinates of the centroid for each rod

BOLOB ANALYSIS: TYPE OF ROD (A OR B)

FINDING CONTOURS

In order to classify all the rods in the image, it is necessary to find their contours.
The ***findContours***() function of OpenCV returns n contours as well as a n×4 matrix called HIERARCHY.

HIERARCHY

Thanks to this matrix it is possible to reconstruct which contours are enclosed in outer contours.
Essentially, it is possible to understand if a contour has any inner contour and in which row of the matrix it is possible to find it.

CLASSIFICATION

To classify a rod it is necessary to count how many holes it has inside itself.
This can be easily achieved by counting the numbers of contours inside each outer contour.

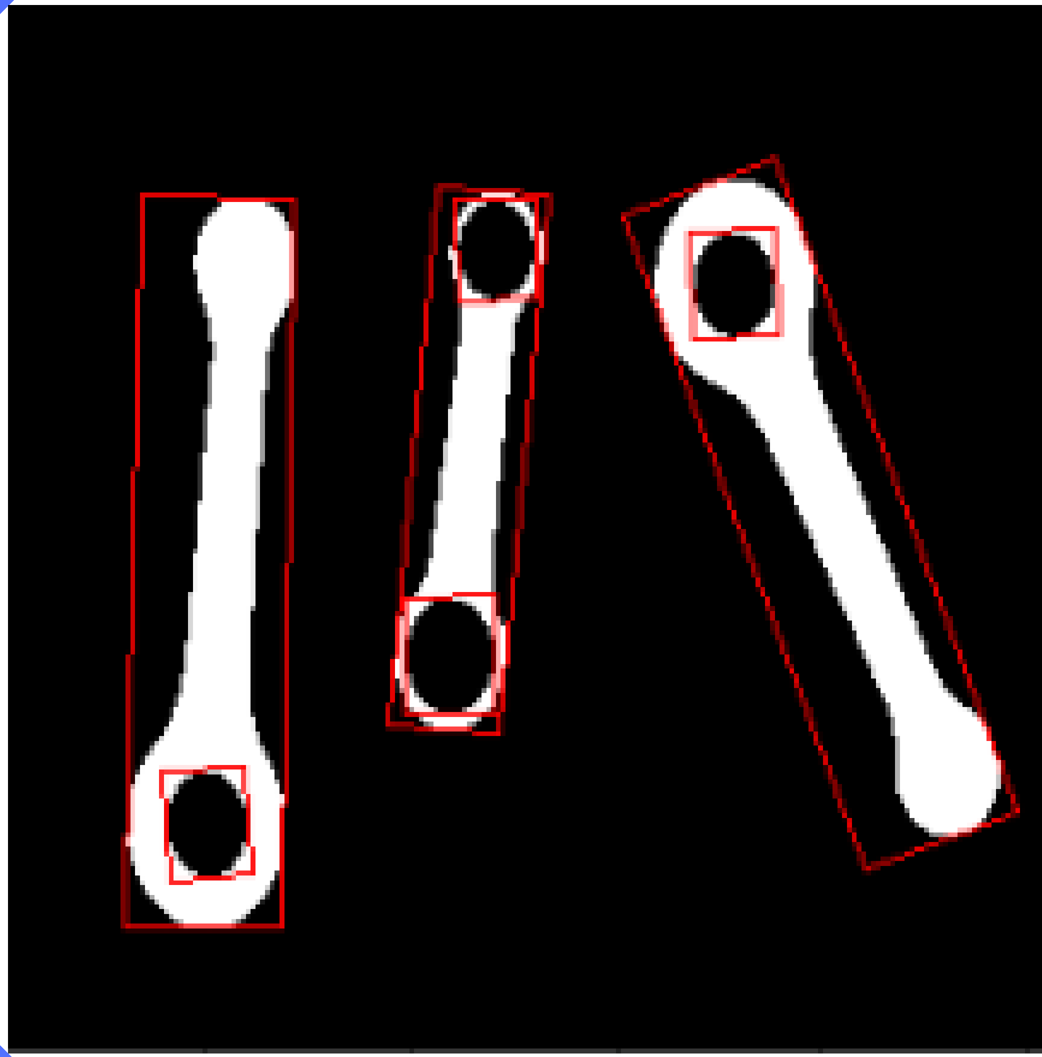
BOLOB ANALYSIS: ENCLOSING RECTANGLES

To compute enclosing rectangles are used two functions of OpenCV:

- ***minAreaRect()***
- ***fitEllipse()***

The first function returns, for each outer contour: position, width and height, and the orientation of the MER/rod.

The second function returns, for each outer contour: position, width and height, and the orientation of the rotated rectangle in which the ellipse is inscribed.



BOLOB ANALYSIS: FINAL STEPS

Now that all the informations have been computed, either during the labelling step or during the enclosing rectangle step, all the measures can be visualized:

```
      ROD: 0
CLASS: ROD_A
POSITION: (55, 141)
ORIENTATION: 88.75
LENGHT: 177.26
WIDTH: 37.27
WIDTH AT THE BARYCENTER : 14.56
***************************************************

       HOLE: 1
CENTER COORDIANTES: (51, 200)
DIAMETER: 23.45
```

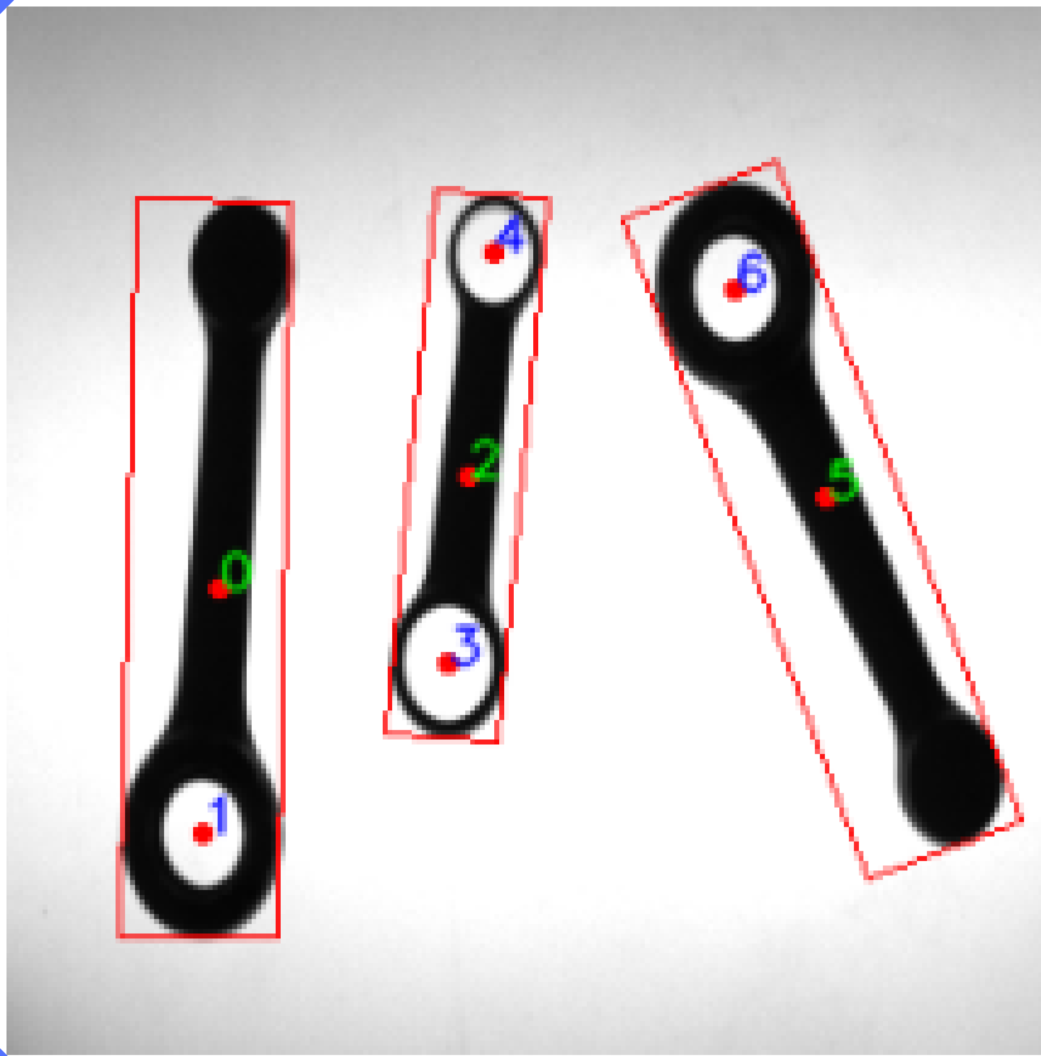


Image denoising (task 2)

1

THE MEDIAN FILTER

In order to remove the iron powder, a median filter has been applied. This type of non-linear filter is used to counteract impulse noise and in this scenario the iron powder falls exactly in this noise category.

2

DENOISING WITHOUT BLURRING

The most important characteristic of this type of filter is that it does not introduce new values like mean filters do. Indeed, it preserves edges by choosing either one value in the high side of the edge or one value in the low side.

3

KERNEL SIZE & NUMBER OF TIMES

The median filter has been applied 10 times with a 3×3 kernel in order to remove the iron powder.