

**Matlab Course: day 4**

# **Image Analysis**

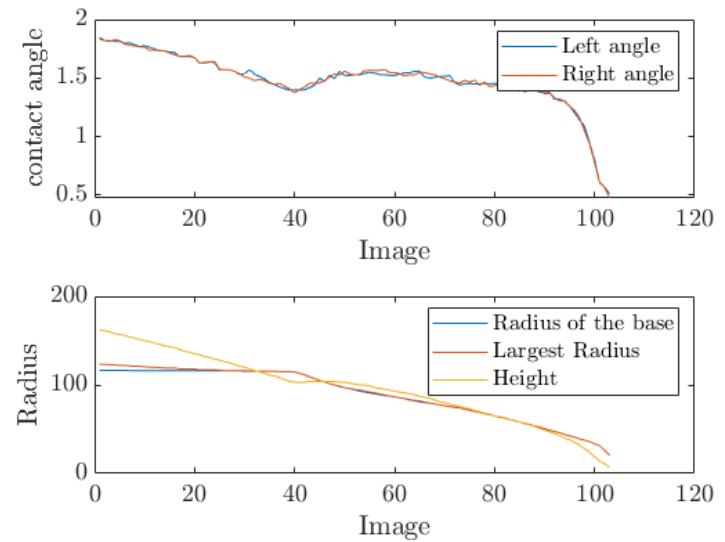
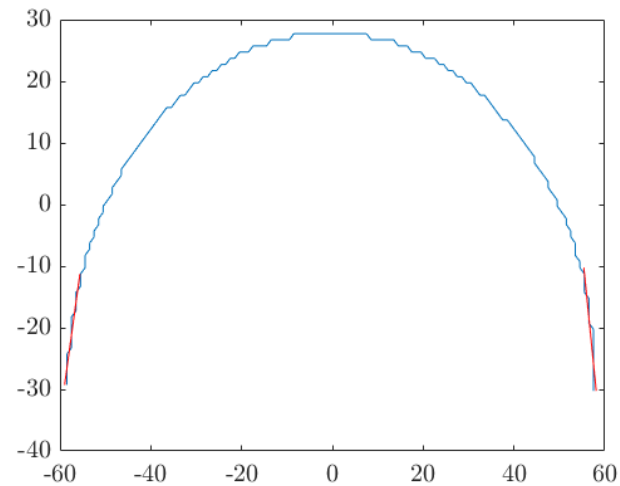
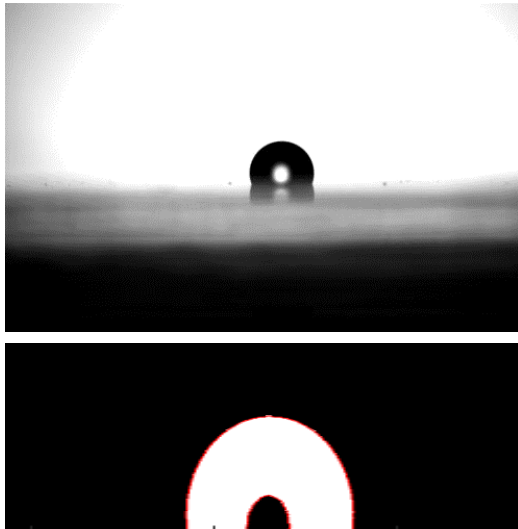
**Charlotte de Blois**



# Intro

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How to extract information from an image?

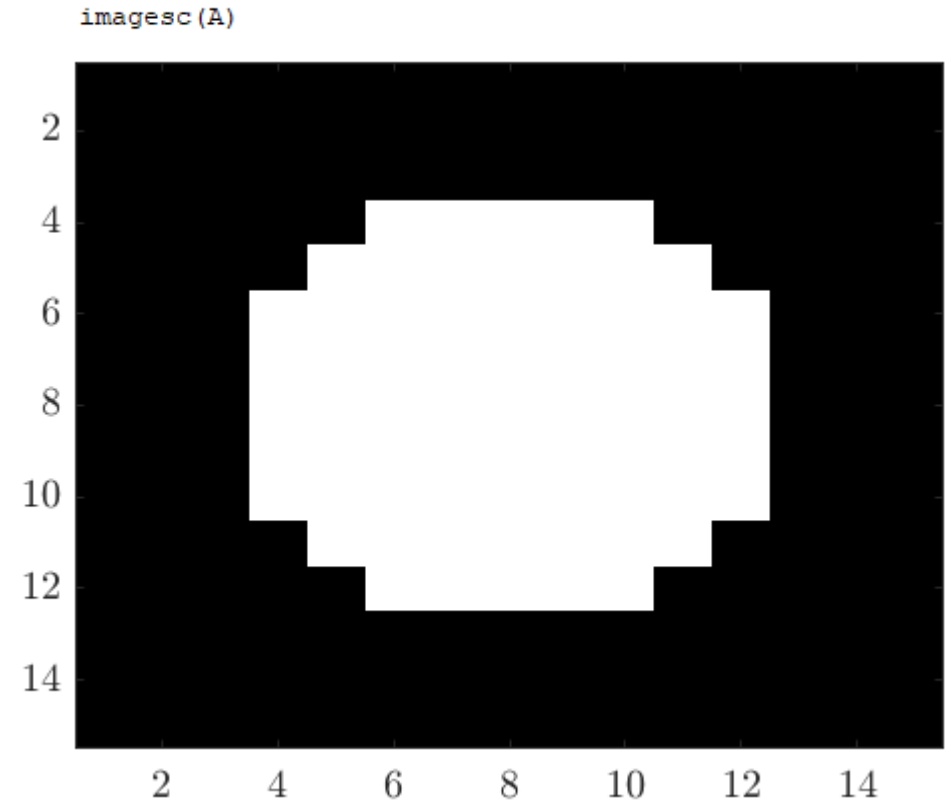


# Part 0 – Image manipulation

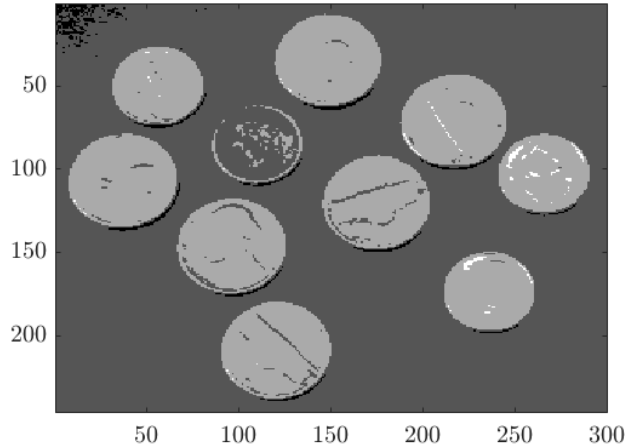
---

```
A =  
  
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  
 0  0  0  0  0  1  1  1  1  1  0  0  0  0  0  
 0  0  0  0  1  1  1  1  1  1  1  0  0  0  0  
 0  0  0  1  1  1  1  1  1  1  1  1  0  0  0  
 0  0  0  1  1  1  1  1  1  1  1  1  0  0  0  
 0  0  0  1  1  1  1  1  1  1  1  1  0  0  0  
 0  0  0  1  1  1  1  1  1  1  1  1  0  0  0  
 0  0  0  0  1  1  1  1  1  1  1  0  0  0  0  
 0  0  0  0  0  1  1  1  1  1  0  0  0  0  0  
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
```

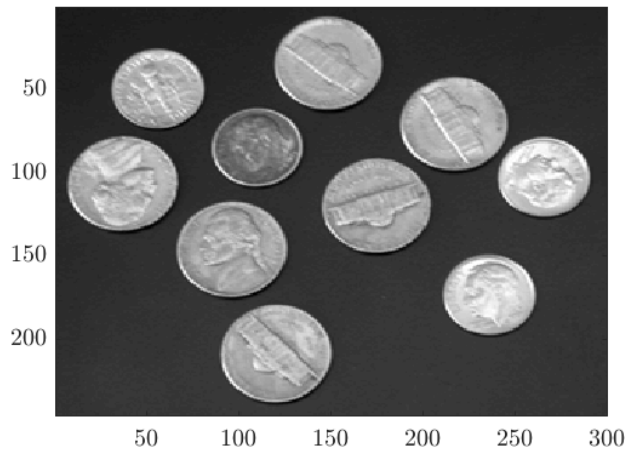
Image = Matrix



# Part 0 - Creating a matrix



-> Stored in uint8 ✗



-> Stored in double ○

# Part 0 - Indexing

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- Exercise

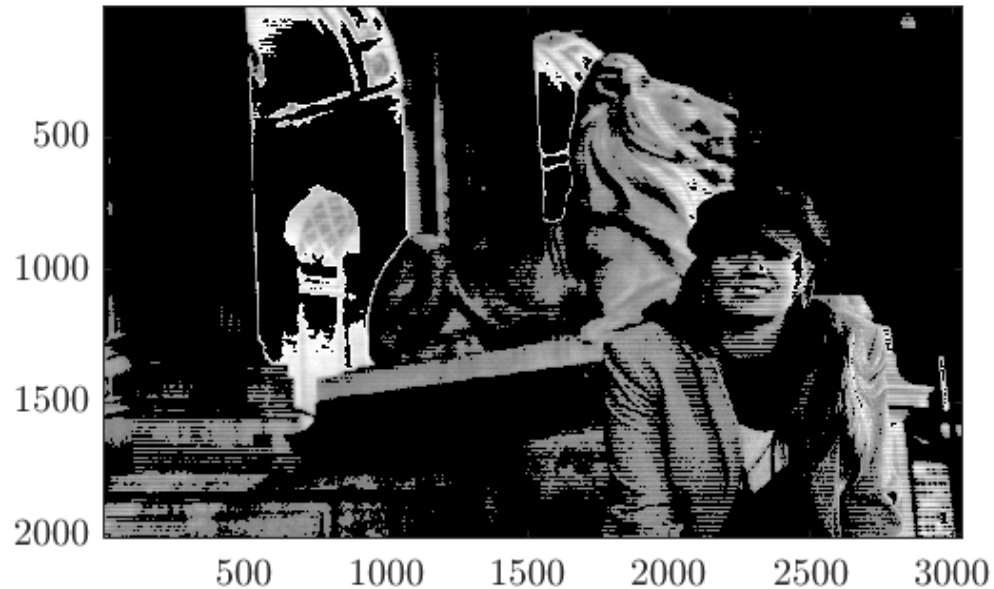


```
% Try to change the pixels higher than  
% 80% or smaller than 20% of the  
% maximum pixel intensity to zero.
```

# Part 0 - Indexing

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- Solution

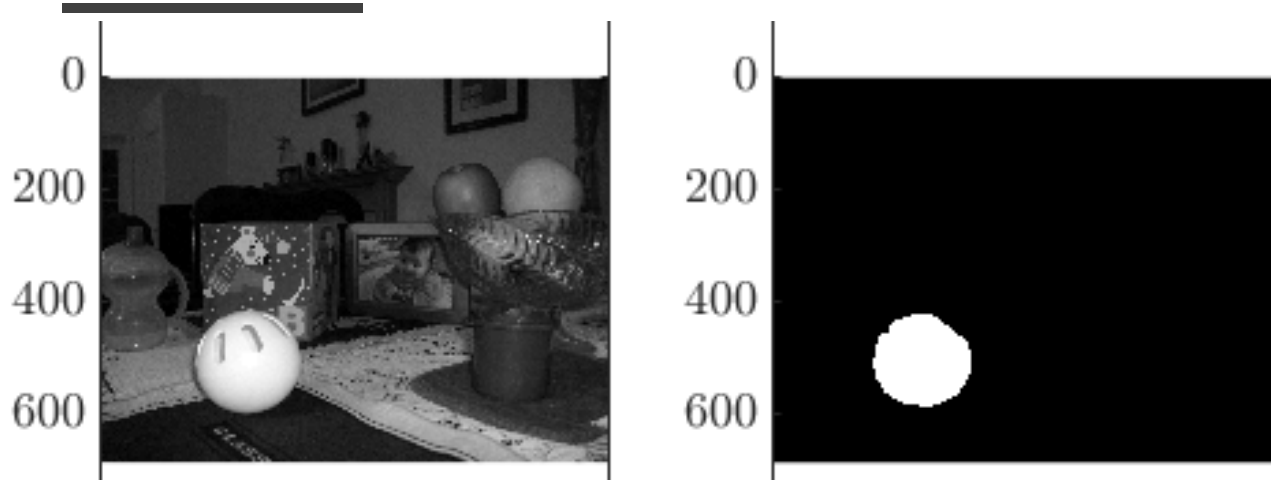


```
% Try to change the pixels higher than  
% 80% or smaller than 20% of the  
% maximum pixel intensity to zero.
```

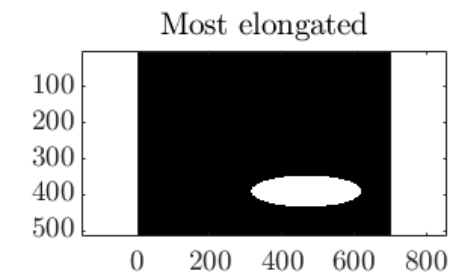
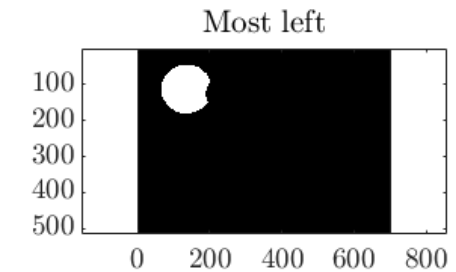
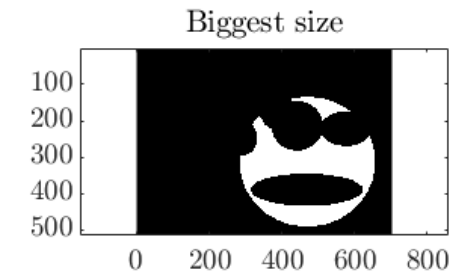
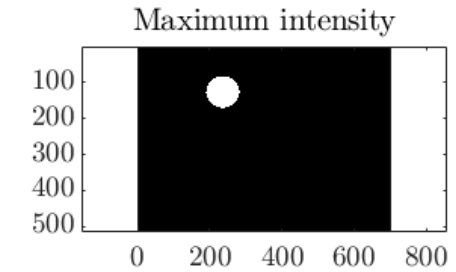
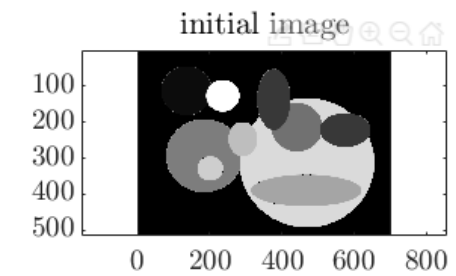


```
figure(1)  
subplot(2,1,1)  
imagesc(Im)  
  
%1/ max:  
M=max(max(Im));  
  
%2/ find  
v=find(Im>0.6*M | Im<0.3*M);  
  
%3/ indexing  
Im(v)=0;  
  
subplot(2,1,2)  
imagesc(Im)
```

# Part 1 – Basic segmentation



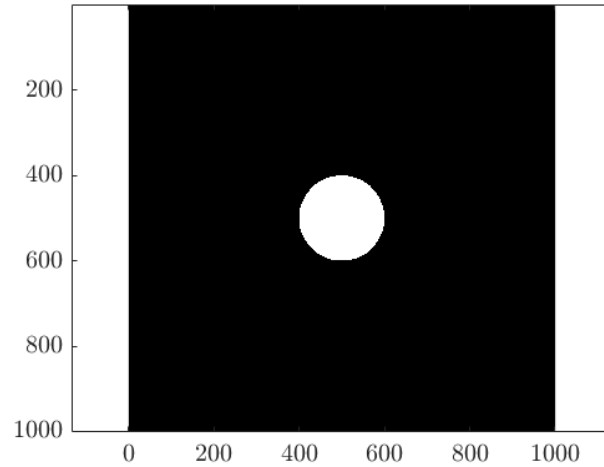
-> what makes the object different from the background?



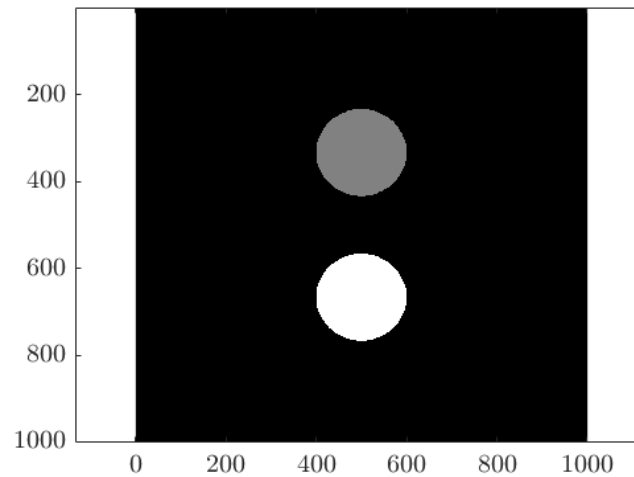
# Part 1 – Step by Step segmentation

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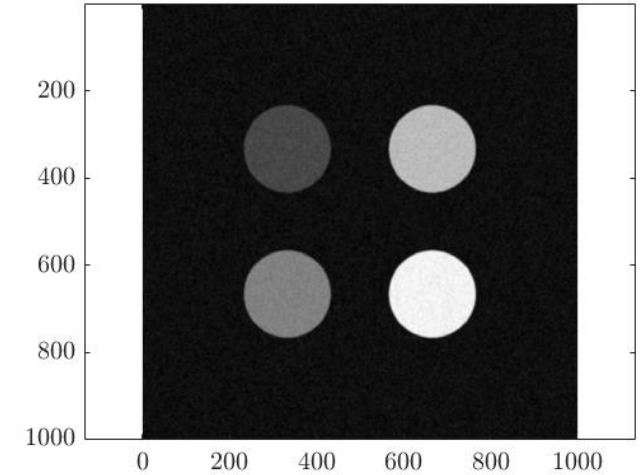
Binary image



Intensity threshold

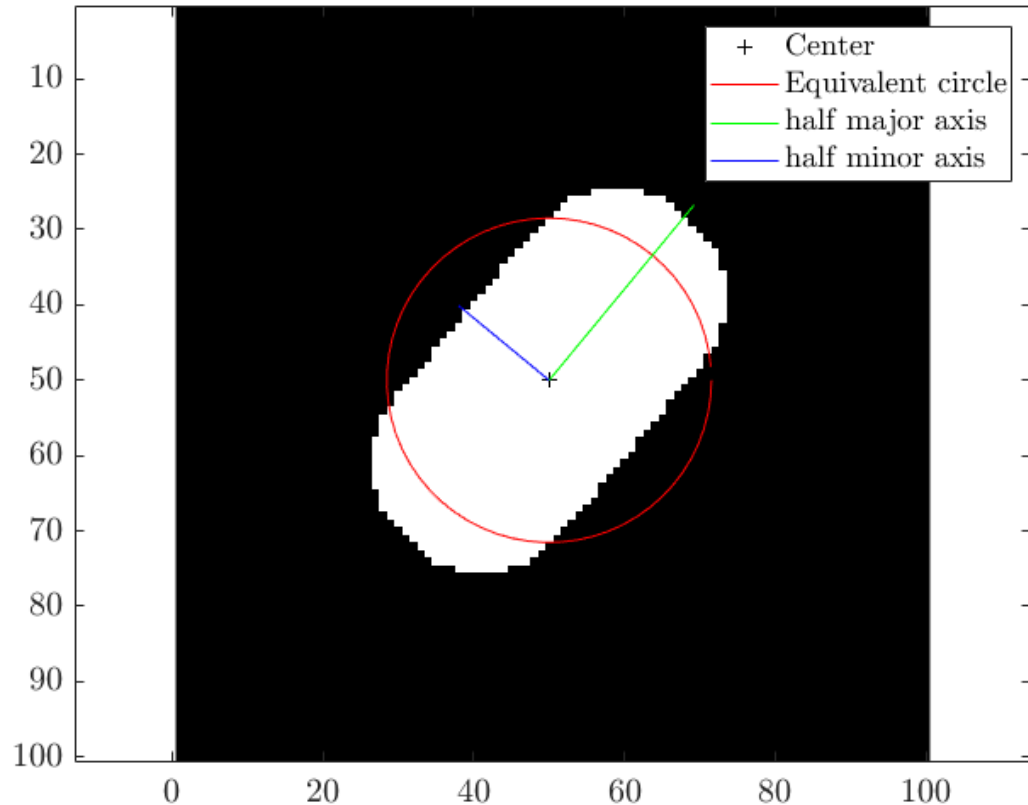


imbinarize



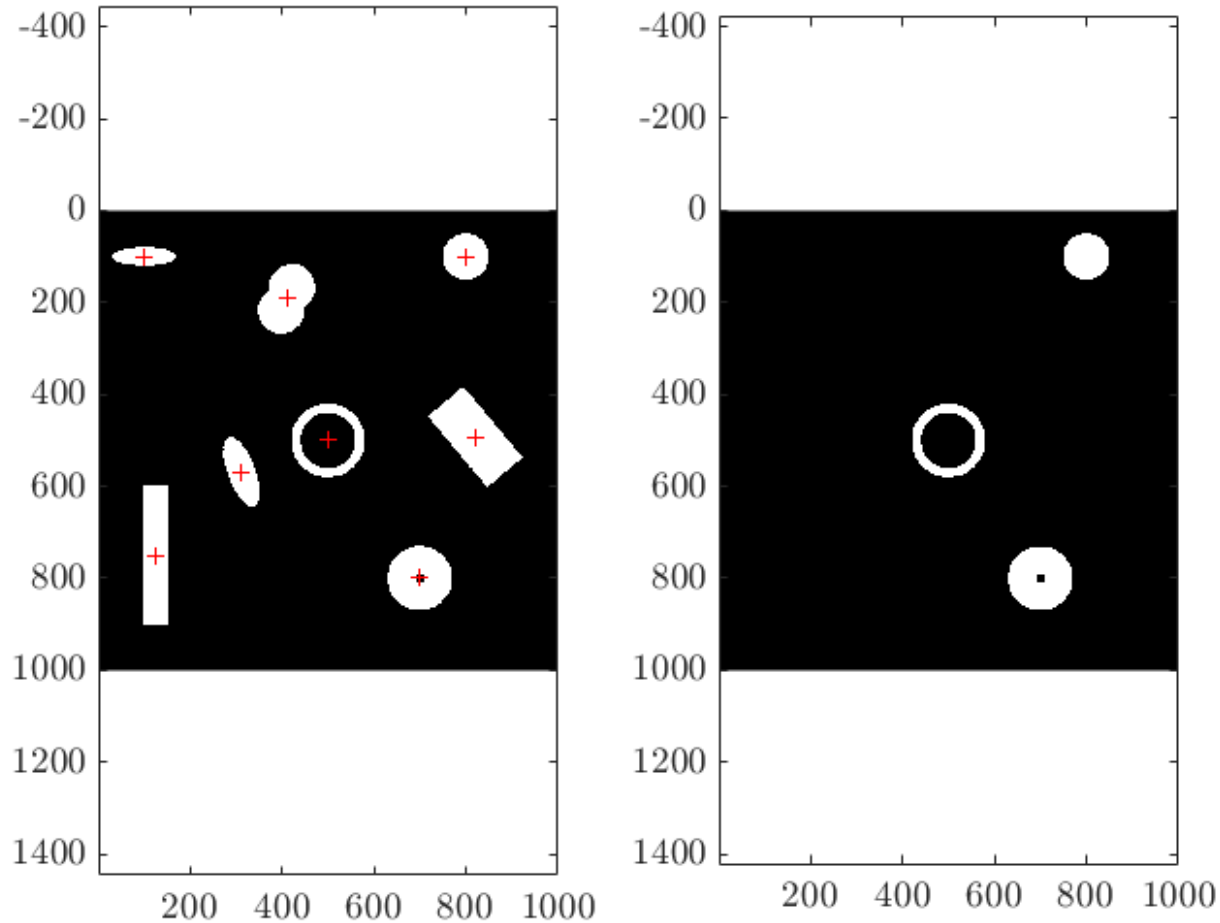


# Part 1 – Object properties



```
prop=regionprops (Im, 'Centroid', 'EquivDiameter', 'MajorAxisLength', 'MinorAxisLength', 'orientation');  
C=prop.Centroid;  
R=prop.EquivDiameter/2;  
a1=prop.MajorAxisLength/2;  
a2=prop.MinorAxisLength/2;  
alpha=prop.Orientation;
```

# Part 1 – Segmenting with geometrical properties



```
%% Getting connected objects
```

```
E=bwconncomp (Im) ;
```

```
%% Extracting centers
```

```
prop=regionprops (E, 'centroid') ;
```

```
C=cat (1,prop.Centroid) ;
```

```
%% Extracting other properties
```

```
prop=regionprops (E, 'MajorAxisLength',  
'MinorAxisLength') ;
```

```
a1=cat (1,prop.MajorAxisLength) ;
```

```
a2=cat (1,prop.MinorAxisLength) ;
```

```
ar=a1./a2 ;
```

```
%% Making a new image
```

```
I2=zeros (size (Im)) ;
```

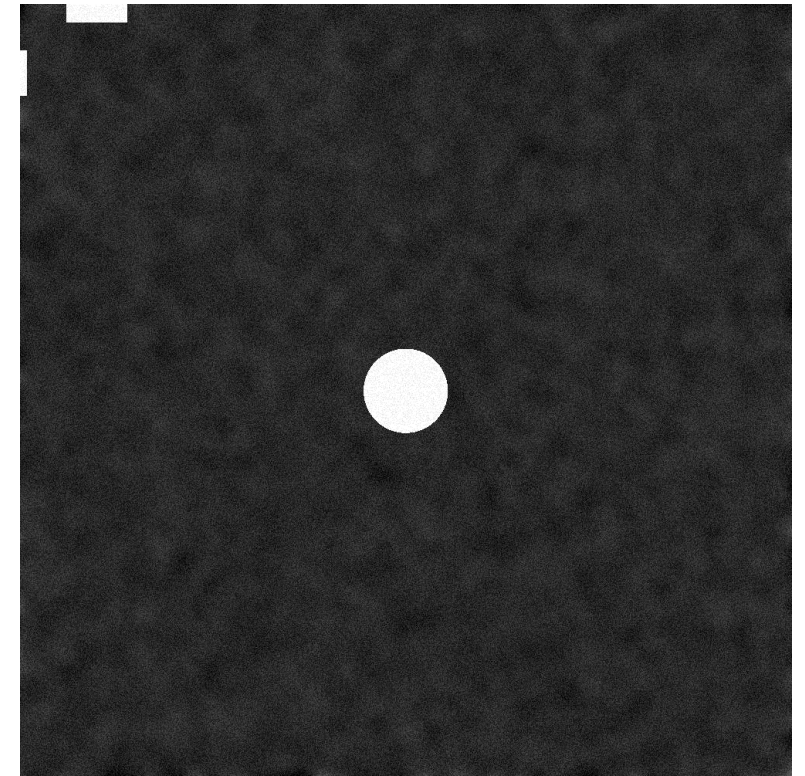
```
pix=cat (1,E.PixelIdxList { (ar==1) }) ;
```

```
I2 (pix)=1
```

-> Try to draw all objects whose centers are in the upper half of the image.

# Part 1 – Application exercise

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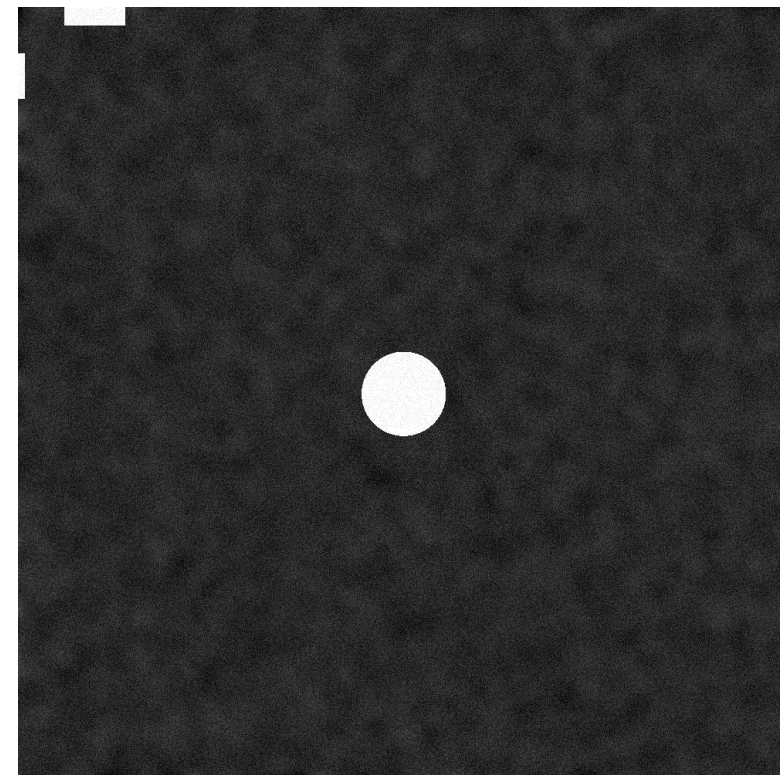
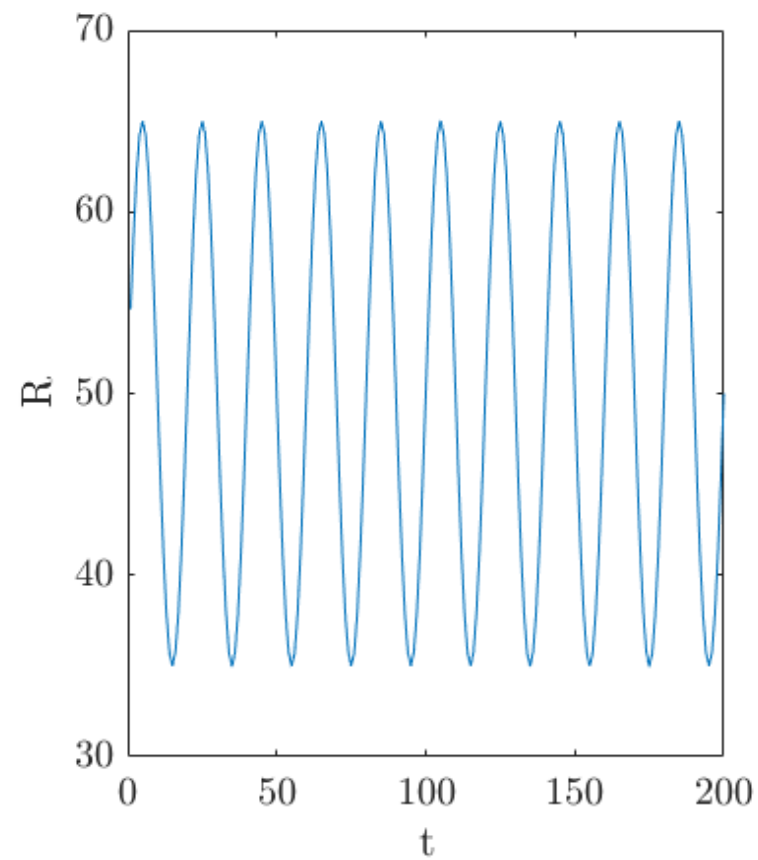
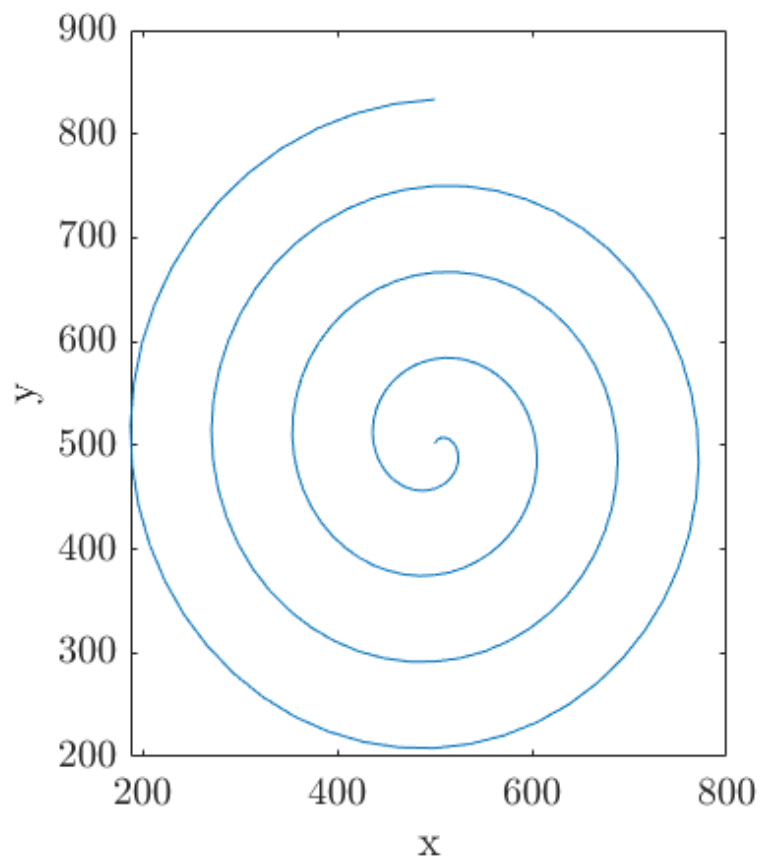


## - Detecting a jumping bubble.

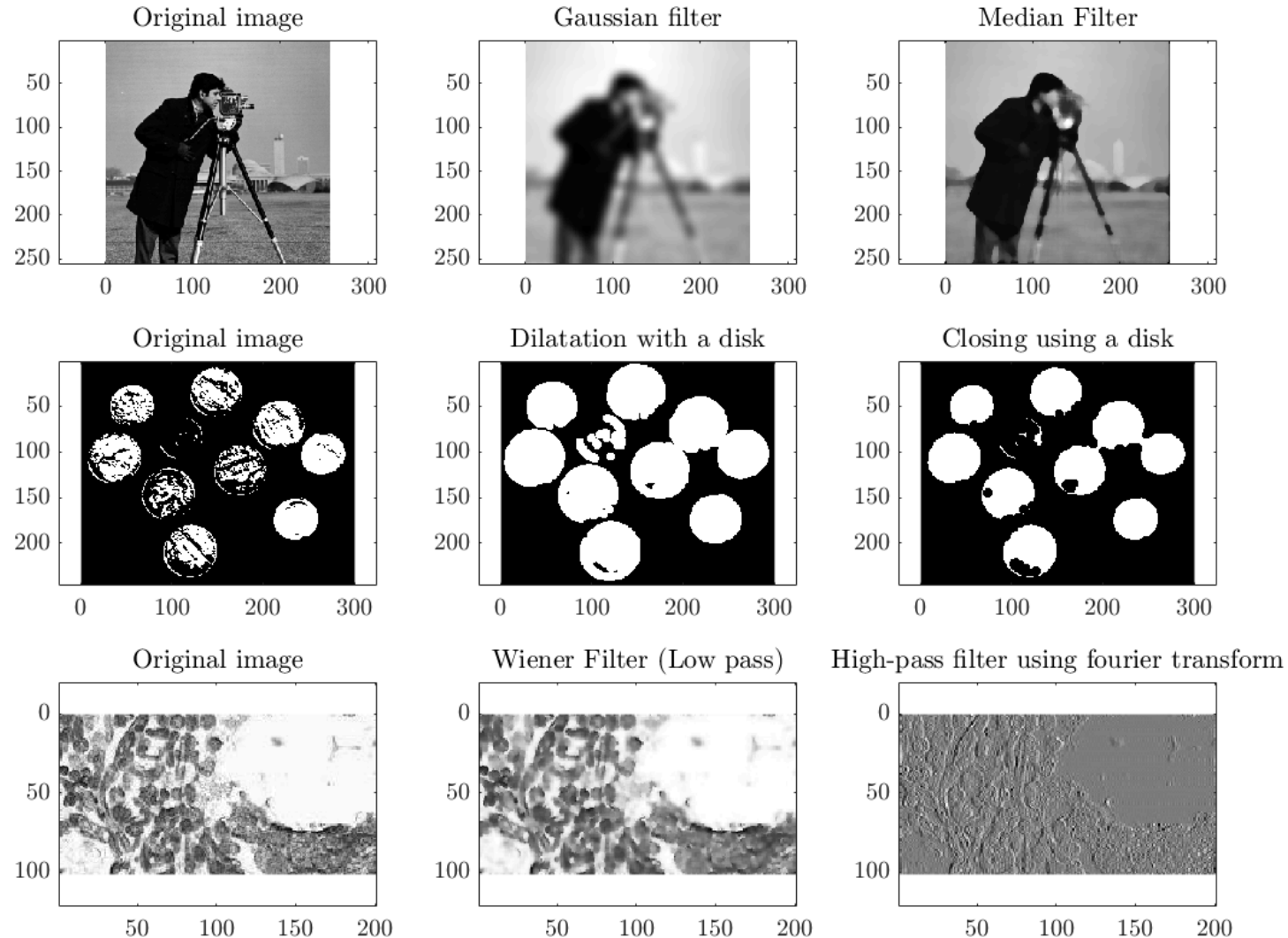
- 1/ Open and visualize JumpingDroplet.avi
- 2/ Binarize the first image
- 3/ Get the position and radius of all objects
- 4/ Segment the bubble for the first image.
- 5/ Make a loop on each image of the movie.
- 6/ For each image, get its position and radius.
- 7/ Plot the evolution of the droplet position and radius with time.

# Part 1 – Solution

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# Part 2 – Background and Filters

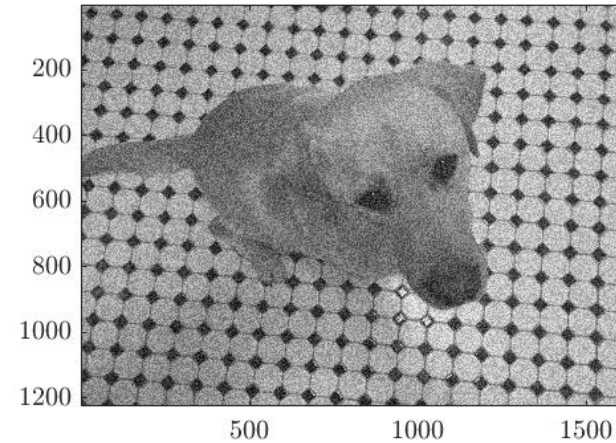


# Part 2 – Application

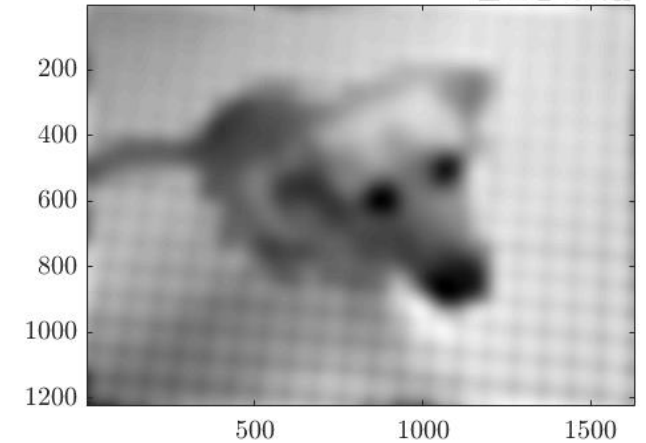
Try to find the filters that made these images.

5 min

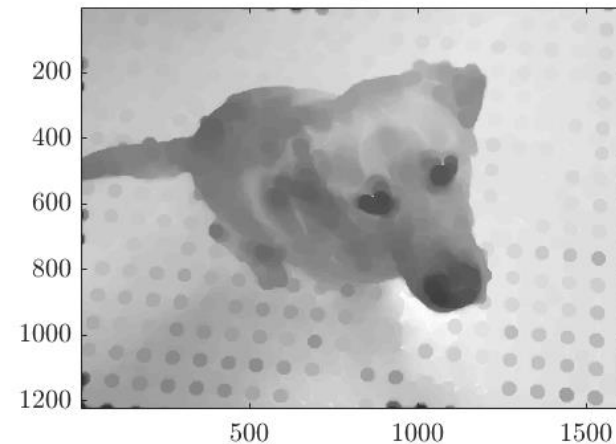
Original



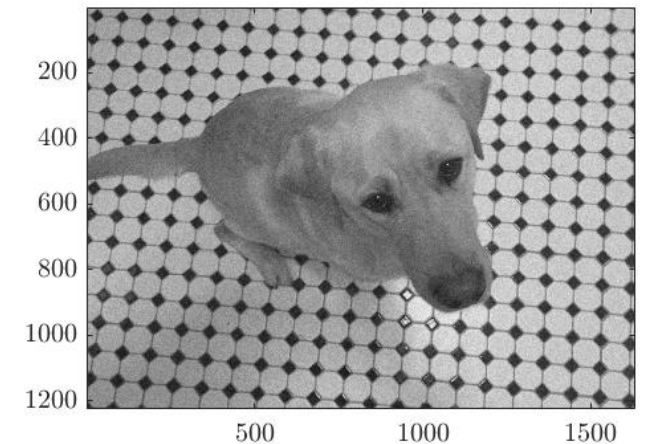
Filter 1



Filter 2

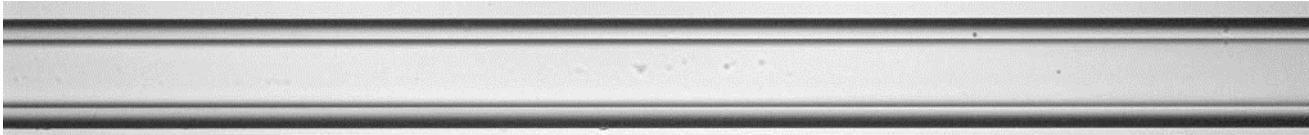


Filter 3

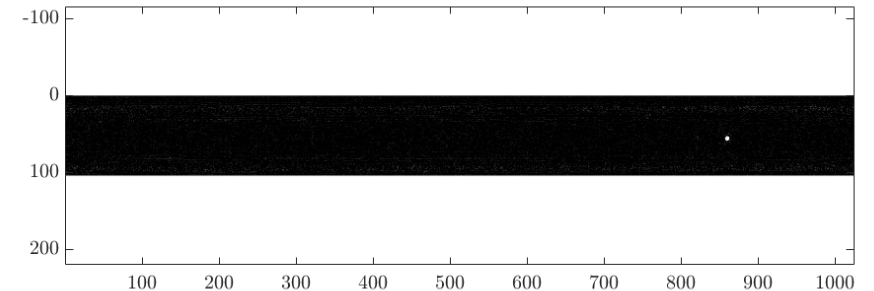
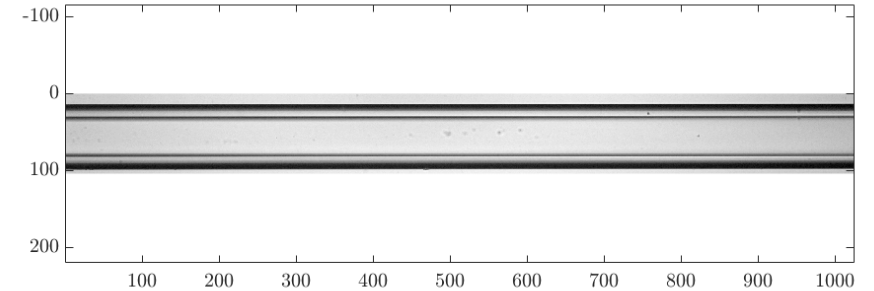
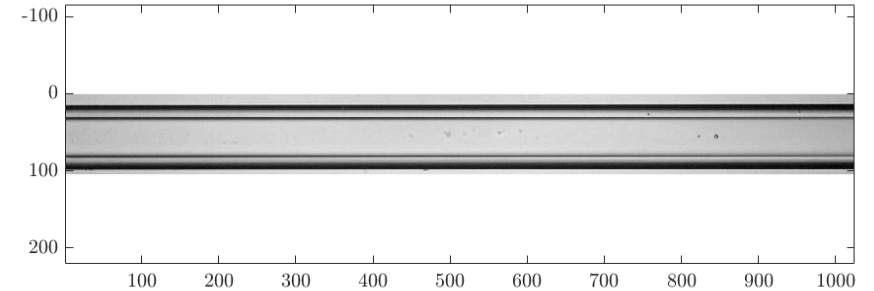


# Part 2 – Making a background

- By time average



- By space average  
i.e gaussian filter/median filter



# Summary

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The standard procedure for image processing:

- 1/ Import image and convert to double
- 2/ Compute/substract background
- 3/ Apply filters : ex noise filters or morphological filters.
- 4/ Binarize
- 5/ Segment object
- 6/ Discriminate objects using their geometrical properties.
- 7/ Get the variable of interest versus time (ex: the position/radius).

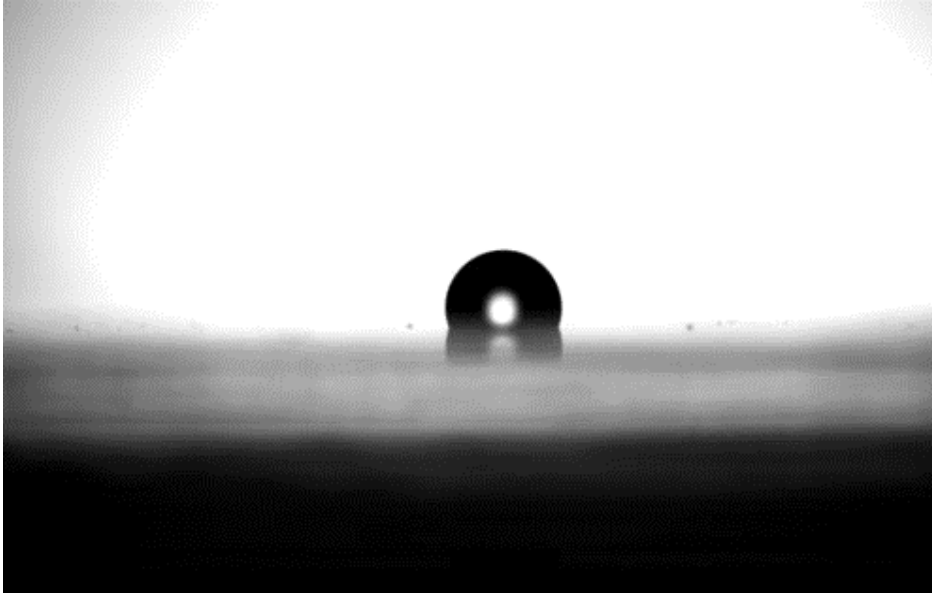


# Application exercises

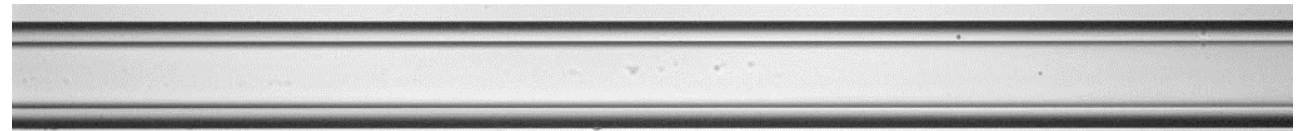
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Ex1: Get the evolution of the distance between droplets with time !



Ex2: Get the radius of droplet with time



Ex3: Get the average velocity of the grains