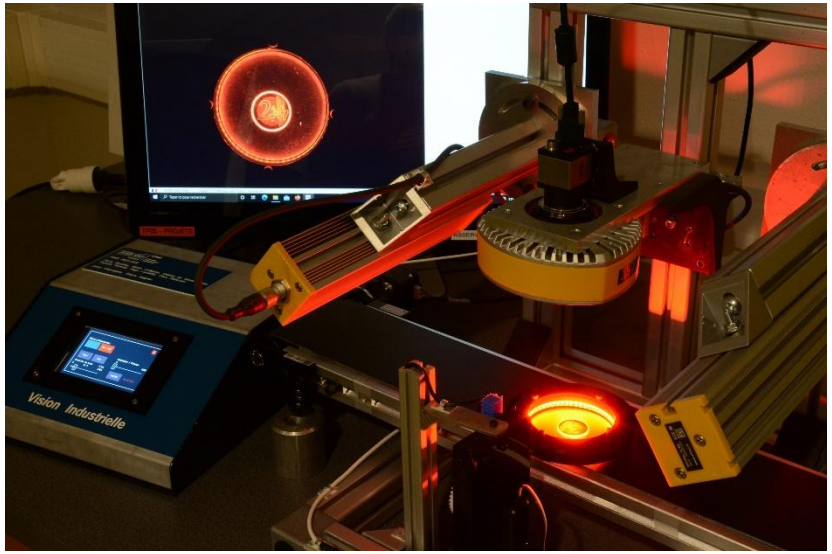
INSTITUT d'OPTIQUE GRADUATE SCHOOL | LEnsE Laboratoire d'Enseignement Expérimental

# Traitement d'image

Pré-traitement / Segmentation / Classification



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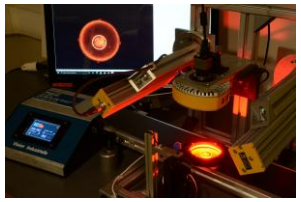

# Traitement d'images

**Objectif**

Image brute 'RAW' / Caméra

- **Bruitée**
- Mauvais contraste
- Eclairage non uniforme
- …

Image souhaitée / Contours bien définis

- Zones homogènes
- Transitions nettes

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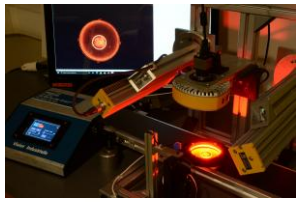
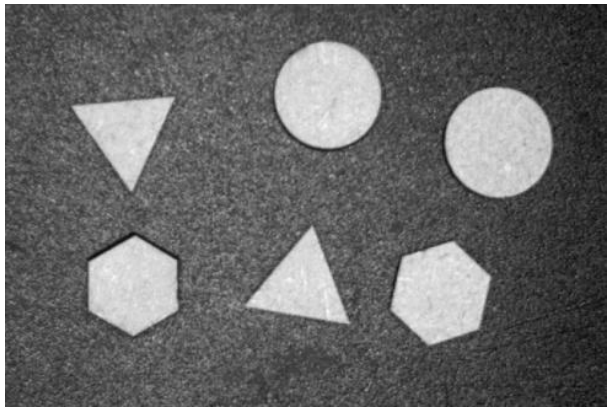
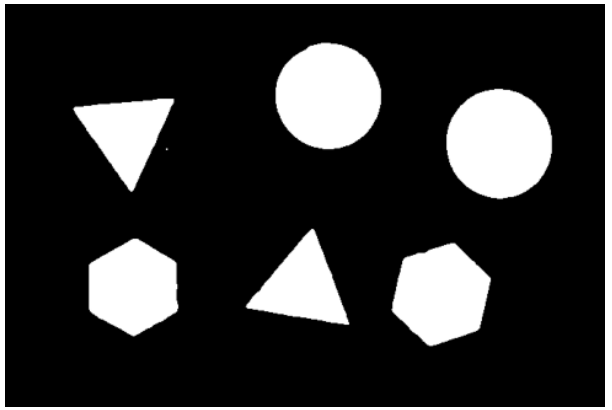


# Traitement d'images





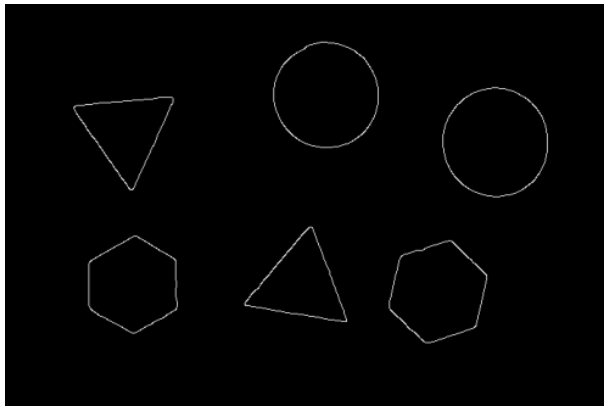


Image brute 'RAW' / Caméra

- **Bruitée**
- Mauvais contraste
- Eclairage non uniforme
- …

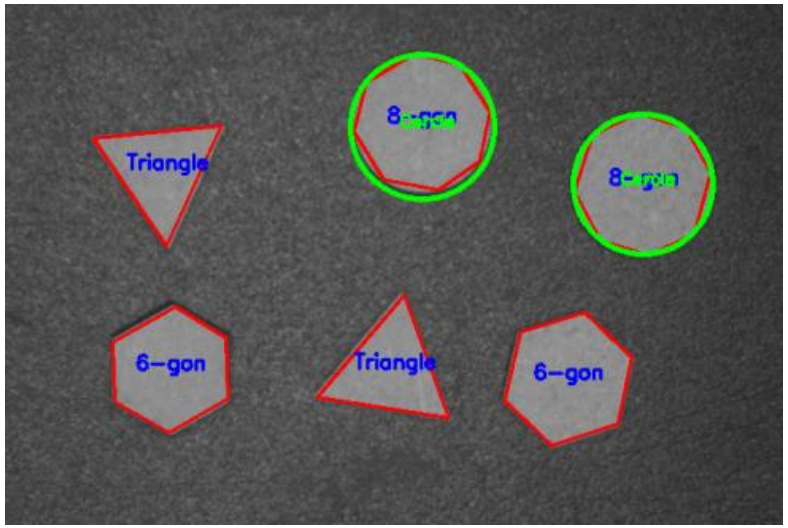
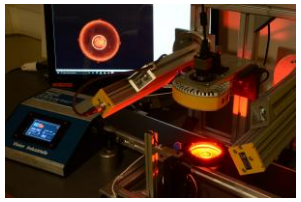



Image souhaitée / Contours bien définis

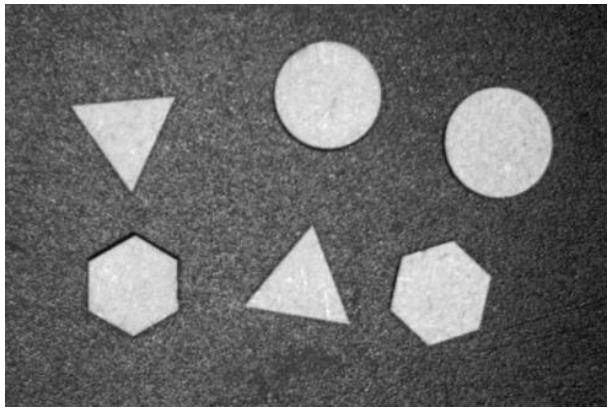
- Zones homogènes
- Transitions nettes

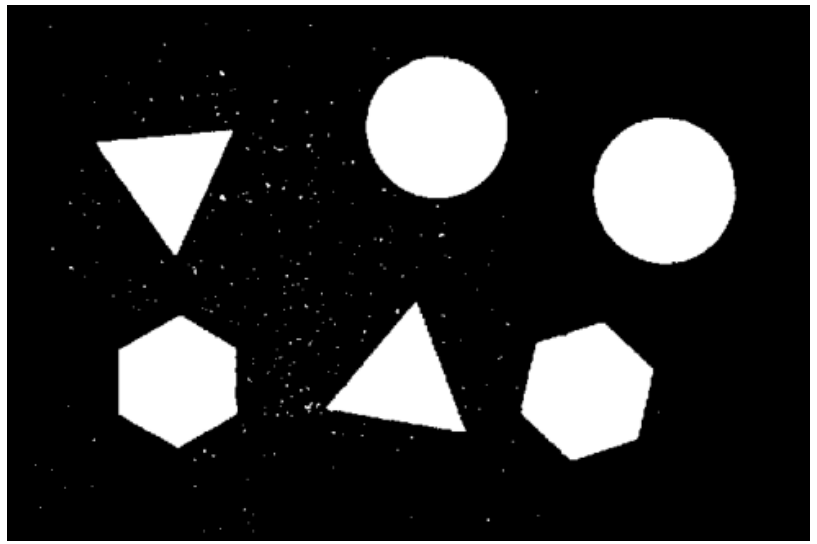
INSTITUT d'OPTIQUE GRADUATE SCHOOL | LEnsE Laboratoire d'Enseignement Expérimental

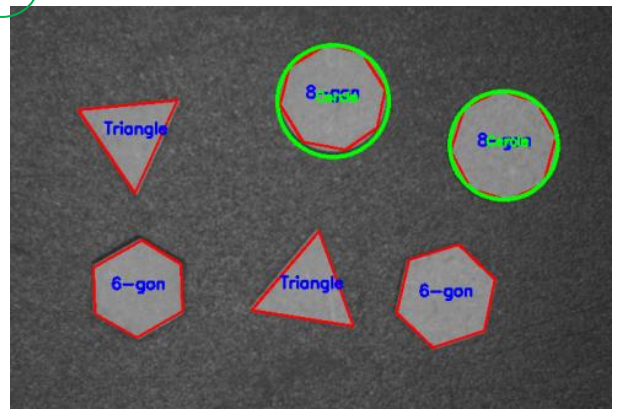


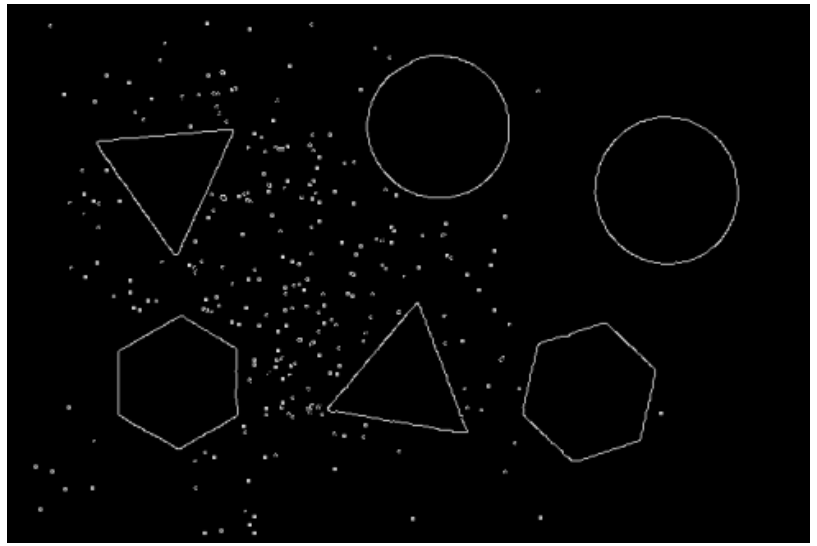
# Traitement d'images

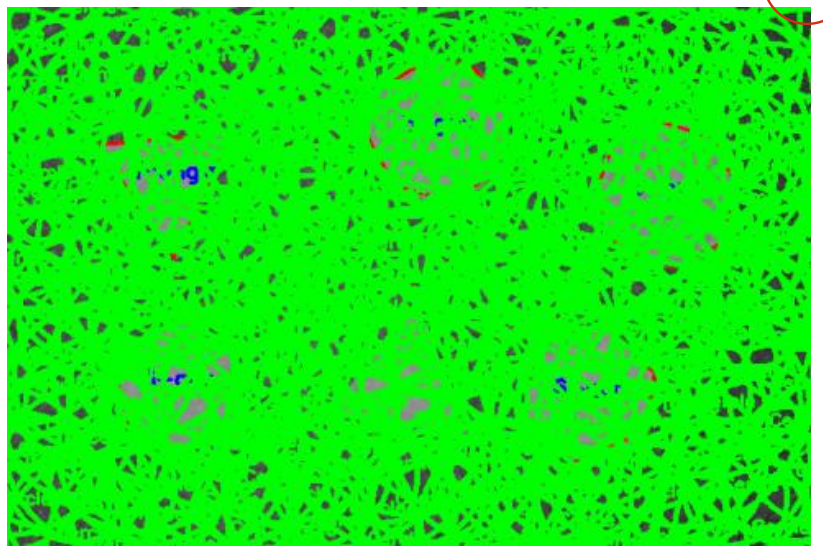
**Mauvais traitement**









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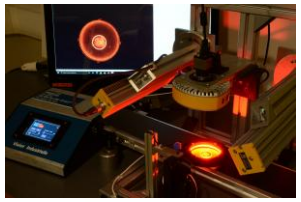
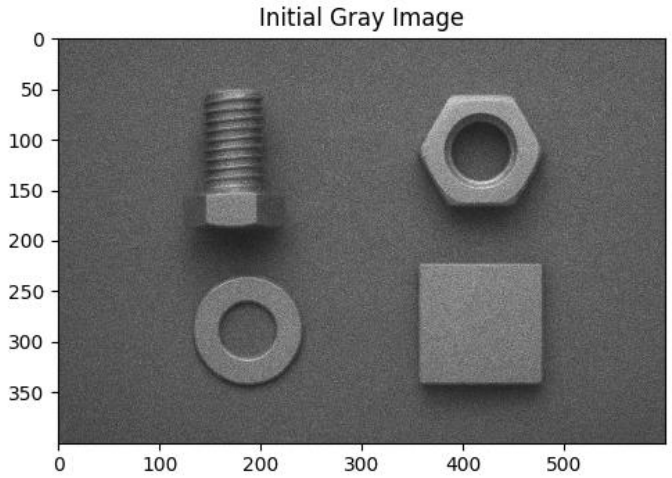
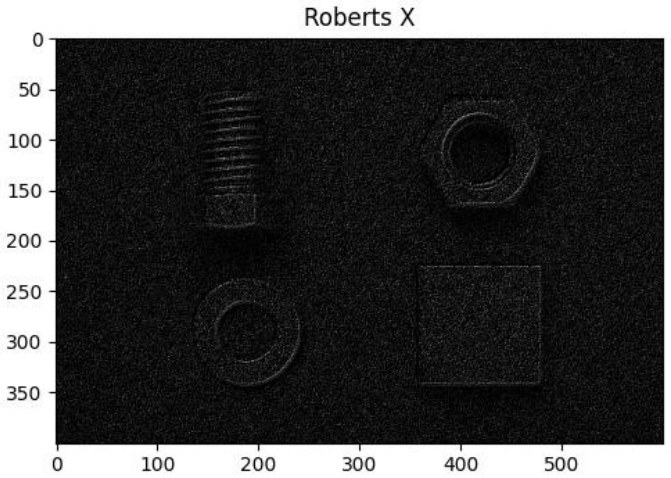
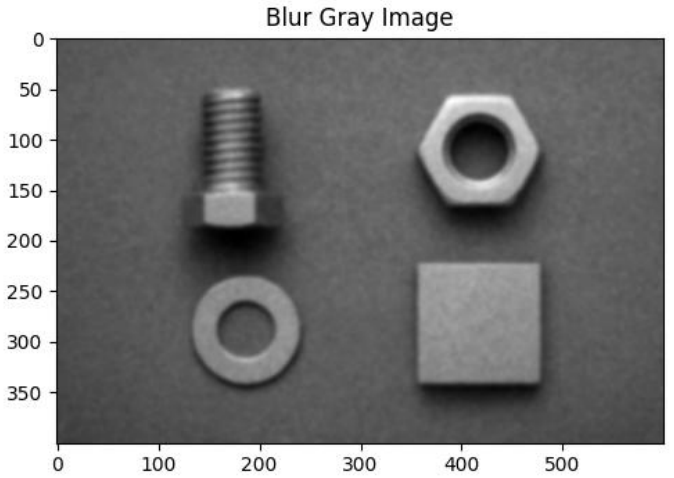


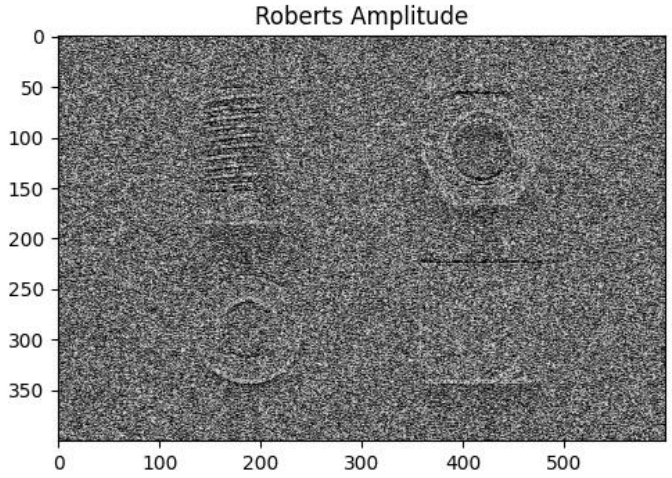
# Traitement d'images

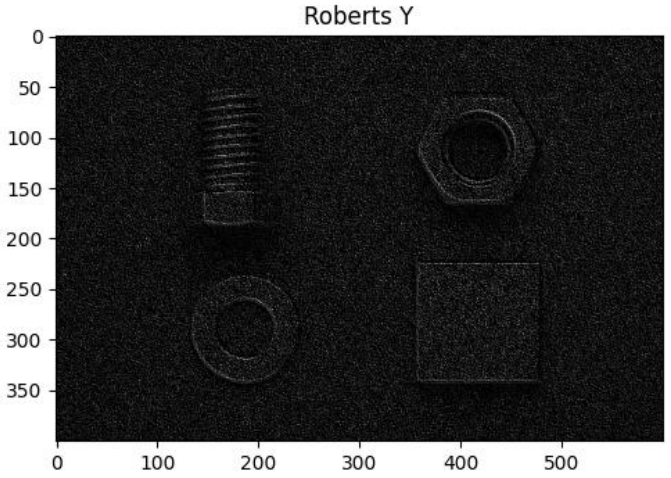
## Exemple industriel

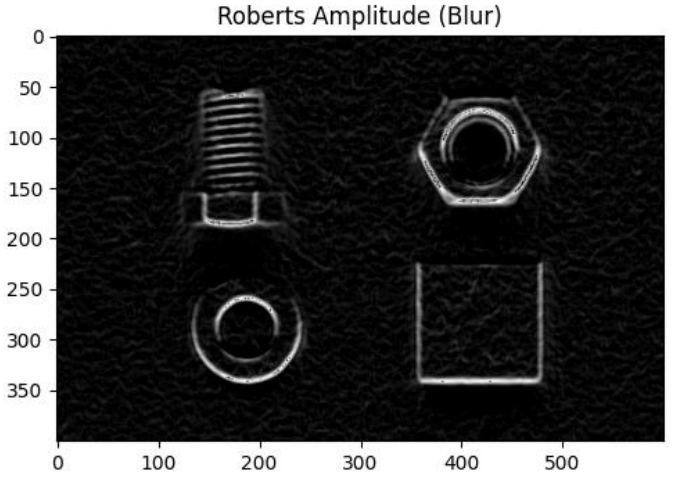


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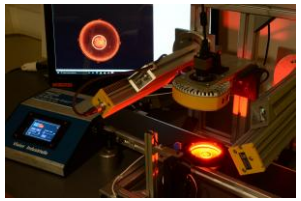

# Traitement d'images

**Objectif**

**Acquisition**

Eclairage, caméra…

**Pré-Traitement**

Filtrage / Réduction bruit
Amélioration contraste
Normalisation

Améliorer la clarté de l'image / réduire les informations indésirables
Faire ressortir les caractéristiques d'intérêt
Standardiser l'échelle ou l'intensité de l'image

**Segmentation**

Seuillage
Détection de contours
Sélection de régions d'intérêt

Isoler les objets de la région d'intérêt (ROI)
Séparer les objets de l'arrière-plan
Identifier les limites et les contours
Se concentrer uniquement sur les parties pertinentes de l'image

**Extraction d'informations**

Formes géométriques
Analyse de textures
Zones uniformes

Extraire des données (taille, forme, position…)
Reconnaitre des formes, des symboles ou des points d'intérêt

**Classification**

Détection d'objets
Reconnaissance
Classification

Identifier et nommer des objets
Vérifier si les données mesurées sont en accord avec un cahier des charges
Catégoriser des objets dans des groupes spécifiques

**Décision**

Tolérances, pièce valide/non valide, retour en temps réel…

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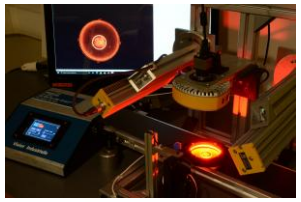


# Traitement d'images

## Images numériques

Image continue

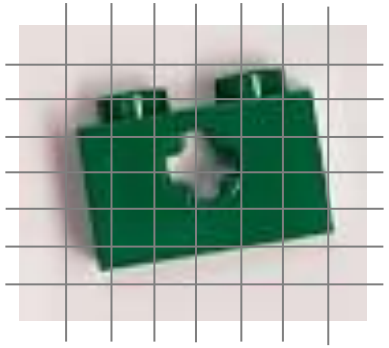
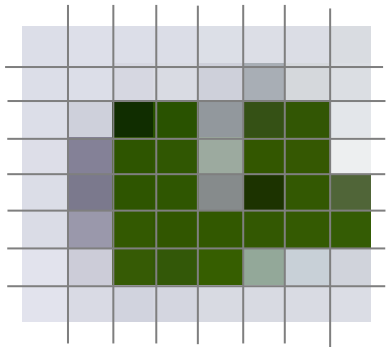
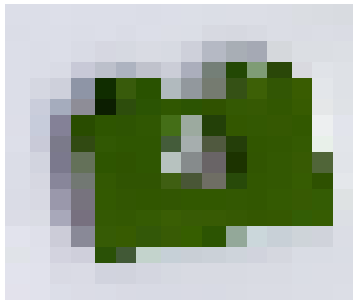


Image numérique : projection sur une matrice d'une image continue



8 x 8 grid



16 x 16 grid

32 x 32 grid

**Image numérique**

Représentation d'une **image sous forme numérique**

*Pour être **sauvegardée**, **traitée** et **affichée** par des ordinateurs ou des systems numériques.*

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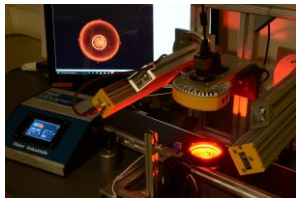
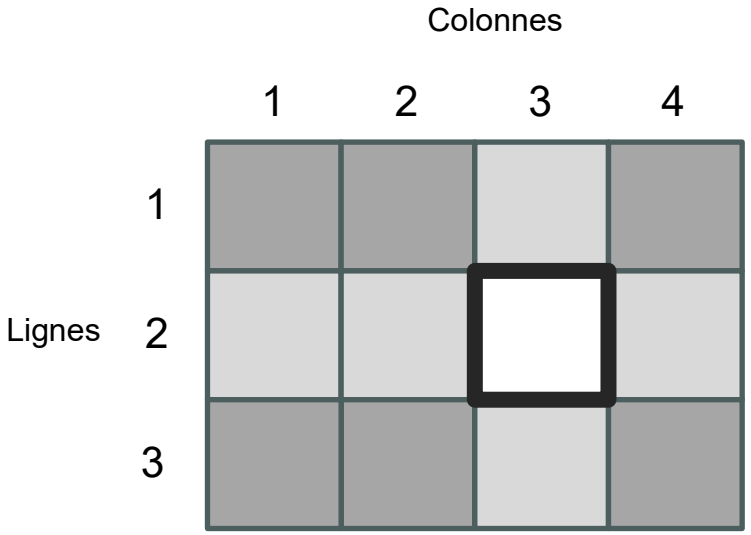


# Traitement d'images

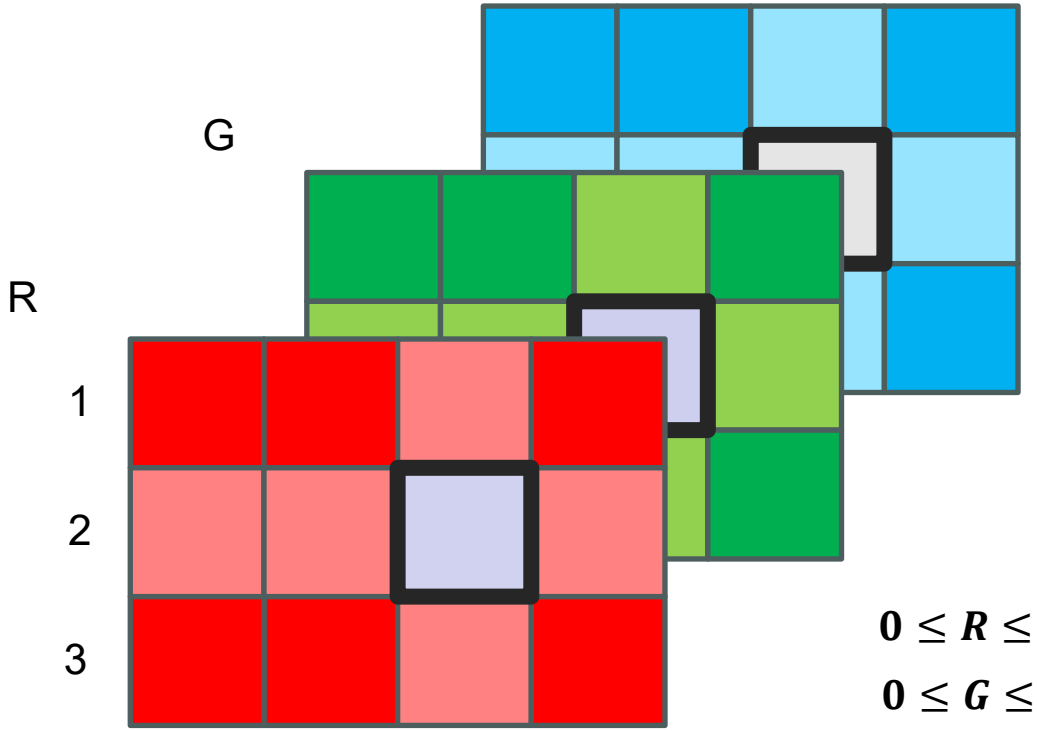
## Images numériques / Gris ou RGB

Gris

**Nb de pixels** = **h** x **v**




Chaque pixel est converti sur **n bits**.




RGB : 3 canaux de 8 bits

$$0 \leq R \leq 255$$
$$0 \leq G \leq 255$$
$$0 \leq B \leq 255$$

R=200, G=100, G=50

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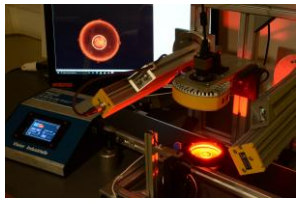


# Traitement d'images

## OpenCV

**Open Source Computer Vision**

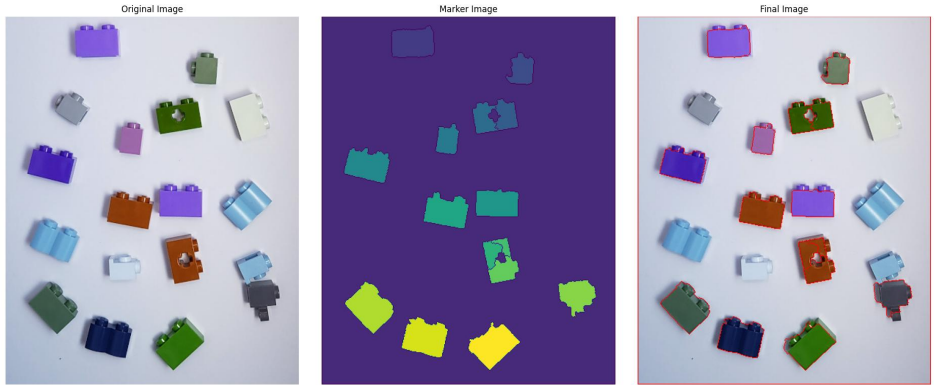
Une bibliothèque de **traitement d'images** et de **Machine learning**

*Développés sur de multiple environnement, comme Python, C++, Java, and MATLAB*

| | |
|---|---|
| **Traitement d'images** | *Filtrage, detection de contours, transformations…* |
| **Reconnaissance** | *Détection d'objets dans des images et des vidéos* |
| **Algorithmes Vidéo** | *Suivi de mouvement, Reconstruction 3D…* |
| **Machine Learning** | *Classification d'images, Reconnaissance de formes* |

OpenCV

https://opencv.org



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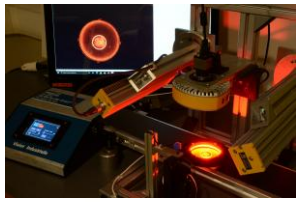
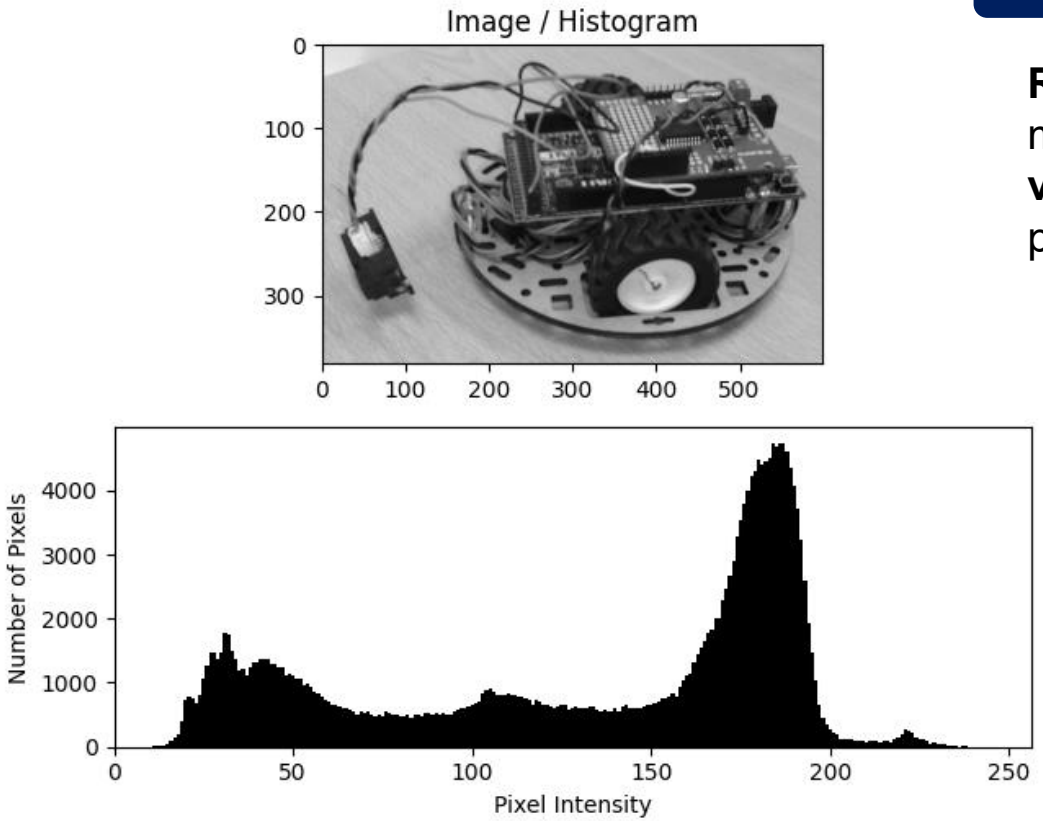


# Traitement d'images

**Filtrage par TF**

## Acquisition




## Histogramme

**Représentation graphique** montrant la **distribution des valeurs de niveaux de gris** des pixels de l'image

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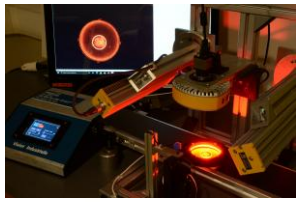
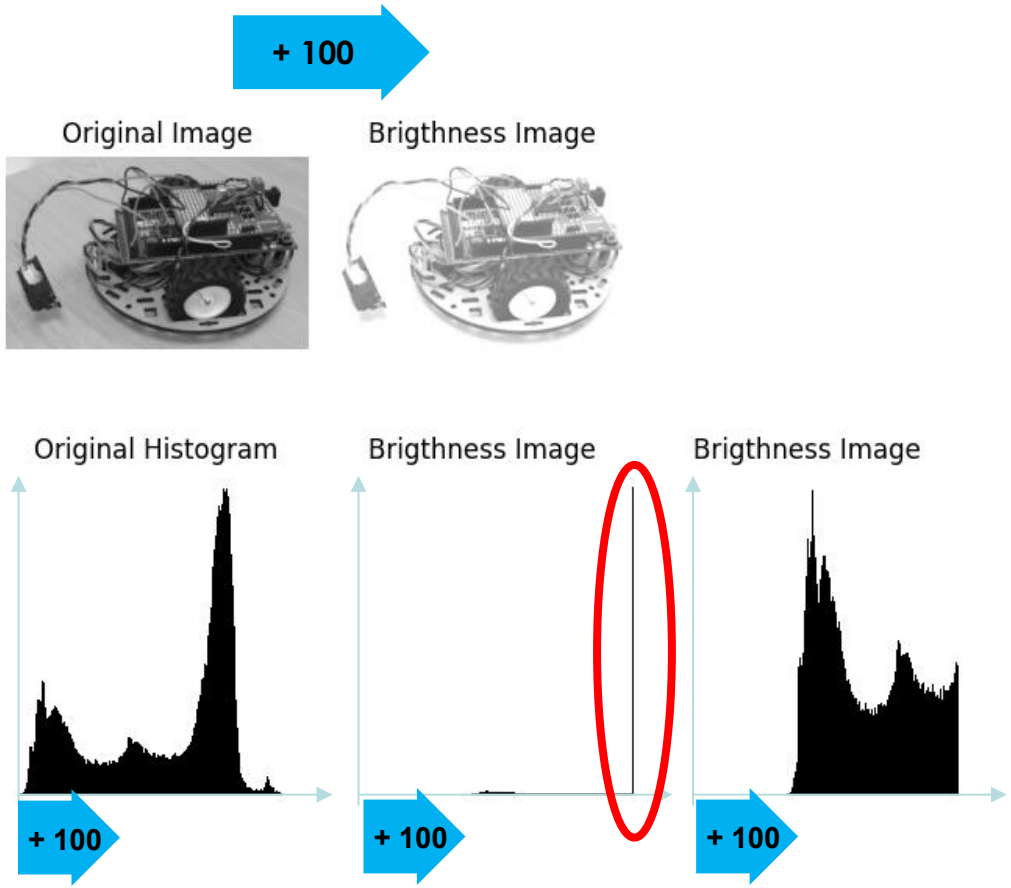


# Traitement d'images

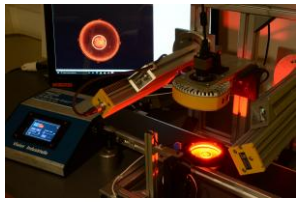
## Amélioration de l'image

Acquisition

Pre Processing



INSTITUT d'OPTIQUE GRADUATE SCHOOL | LEnsE Laboratoire d'Enseignement Expérimental

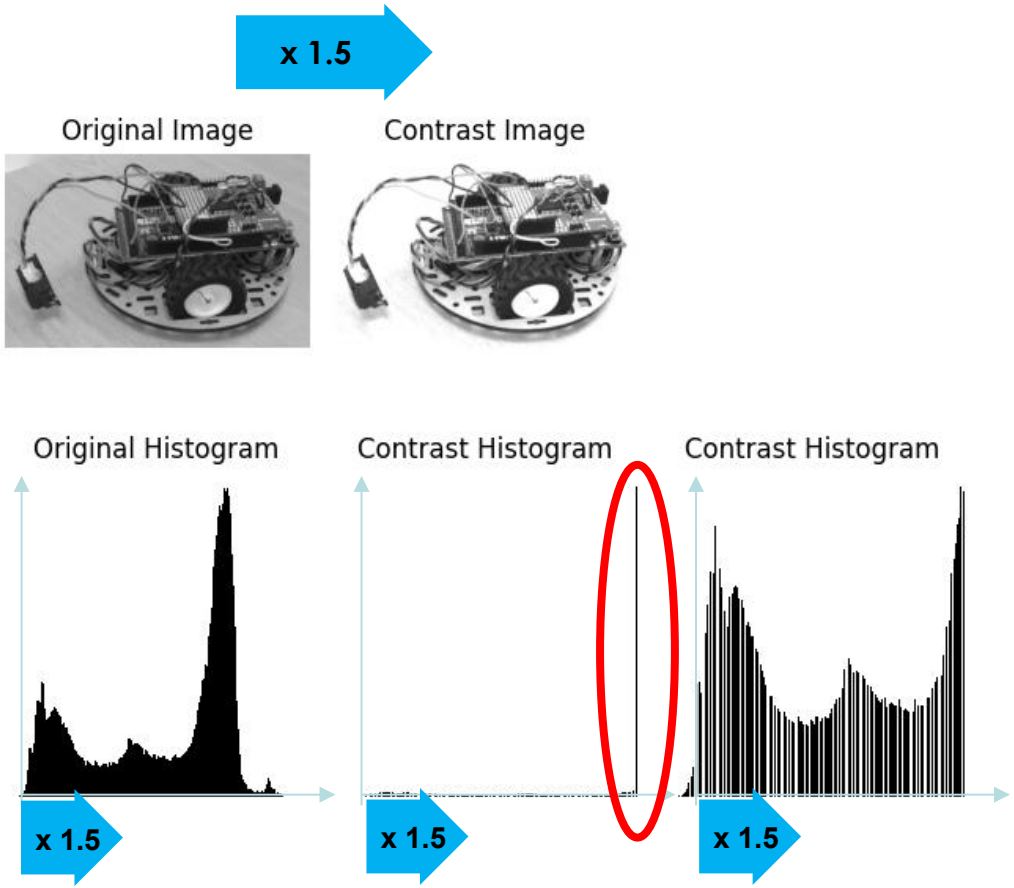


# Traitement d'images

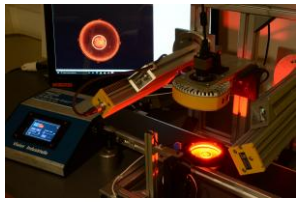
## Amélioration de l'image

Acquisition

Pre Processing



INSTITUT d'OPTIQUE GRADUATE SCHOOL | LEnsE Laboratoire d'Enseignement Expérimental



# Traitement d'images

Acquisition

Pre Processing

## Filtrage / Convolution

kernel

| | | |
|---|---|---|
| -1 | 0 | -2 |
| 1 | 5 | 1 |
| -2 | 0 | -1 |

original image

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | 8 | 4 | 2 | 3 | 1 | 5 |
| 9 | 5 | 1 | 8 | 7 | 6 | 2 |
| 5 | 7 | 1 | 5 | 6 | 8 | 7 |
| 5 | 8 | 2 | 8 | 4 | 3 | 3 |
| 5 | 6 | 6 | 7 | 2 | 5 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | 8 | 4 | 2 | 3 | 1 | 5 |
| 9 | 5 | 1 | 8 x -1 | 7 x 0 | 6 x -2 | 2 |
| 5 | 7 | 1 | 5 x 1 | 6 x 5 | 8 x 1 | 7 |
| 5 | 8 | 2 | 8 x -2 | 4 x 0 | 3 x -1 | 3 |
| 5 | 6 | 6 | 7 | 2 | 5 | 1 |

R = -8 + 0 – 12 + 5 + 30 + 8 – 16 + 0 – 3
R = 4

filtered image

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | 4 | | |
| | | | | | | |
| | | | | | | |

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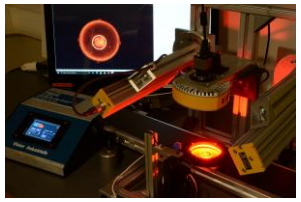


# Traitement d'images

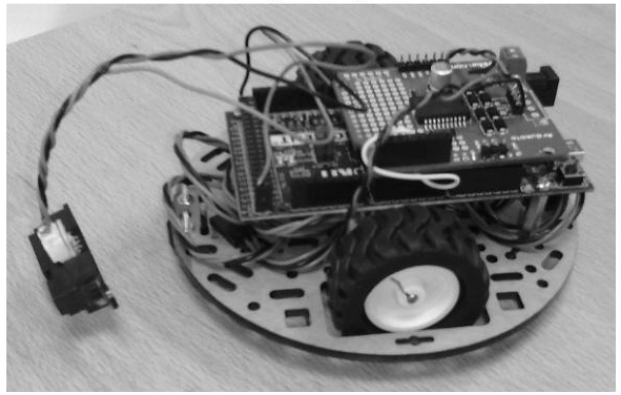
## Filtrage / Convolution

Acquisition

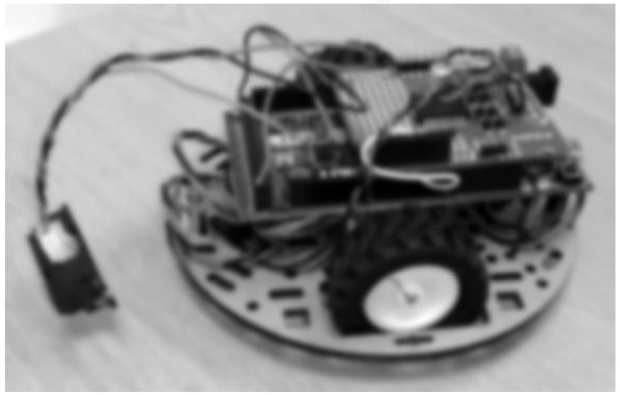
Pre Processing

Suppression de détails insignifiants

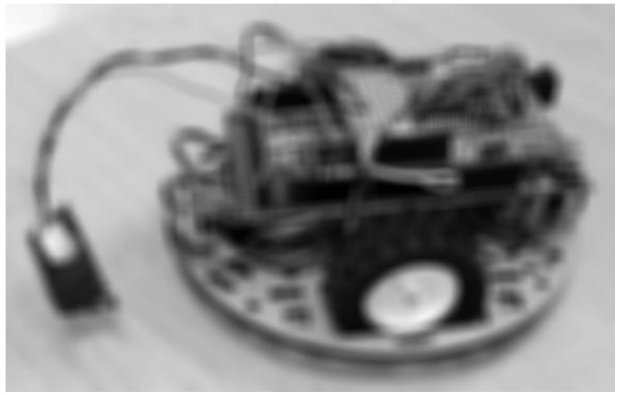
Original Image



Gaussian Blur Image



Median/Box Blur Image



| | | | | |
|---|---|---|---|---|
| 1 | 4 | 7 | 4 | 1 |
| 4 | 16 | 26 | 16 | 4 |
| 7 | 26 | 41 | 26 | 7 |
| 4 | 16 | 26 | 16 | 4 |
| 1 | 4 | 7 | 4 | 1 |

***Gaussian Kernel***
(x 1/273)

***Mean Kernel*** ( x 1/(N*M) )

| | | |
|---|---|---|
| 1/9 | 1/9 | 1/9 |
| 1/9 | 1/9 | 1/9 |
| 1/9 | 1/9 | 1/9 |

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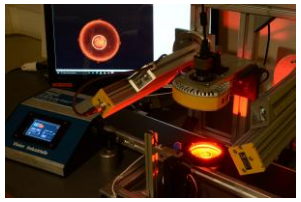
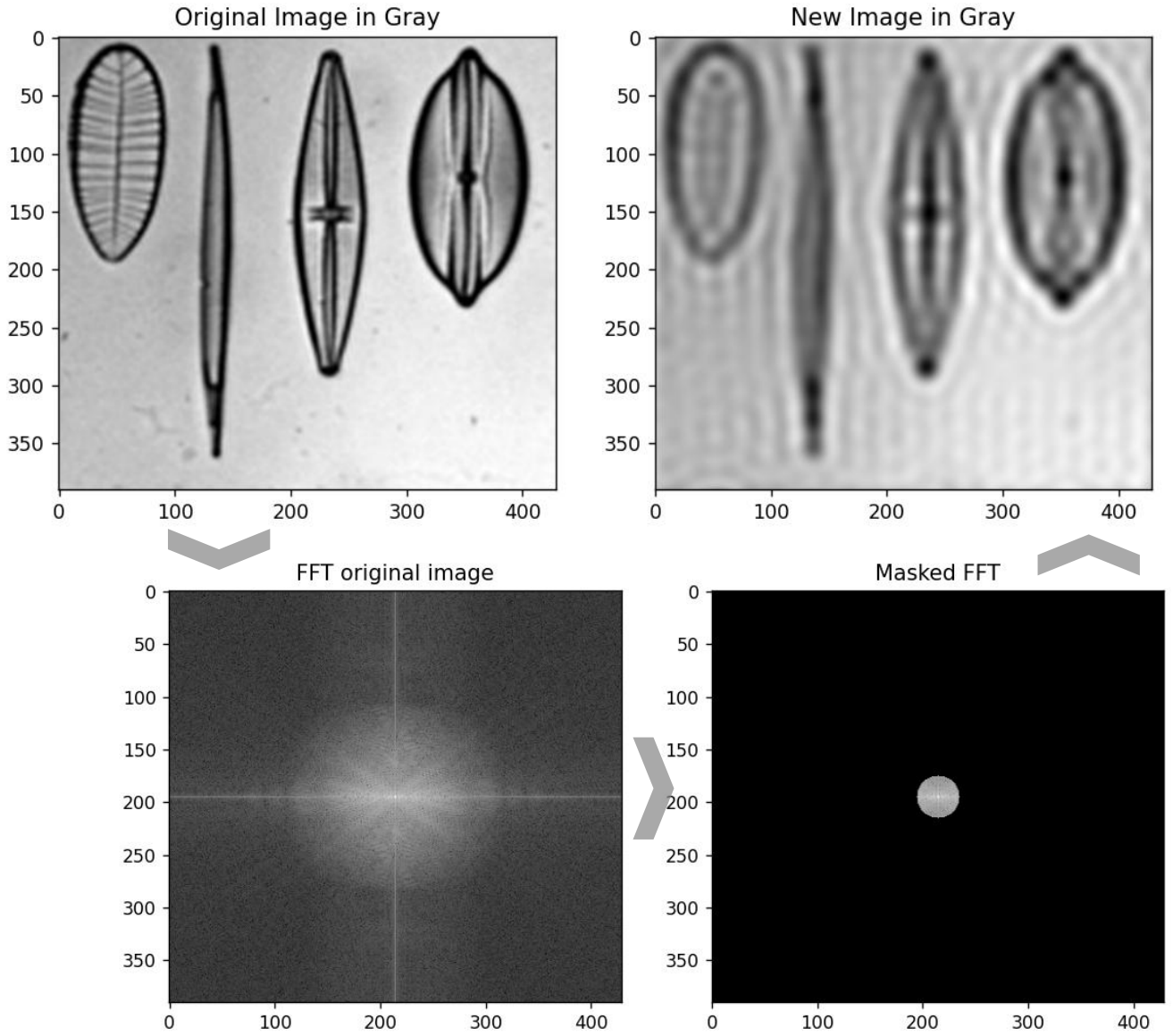


# Traitement d'images

Acquisition

Pre Processing

## Filtrage par TF



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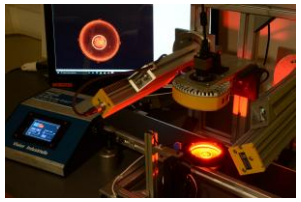
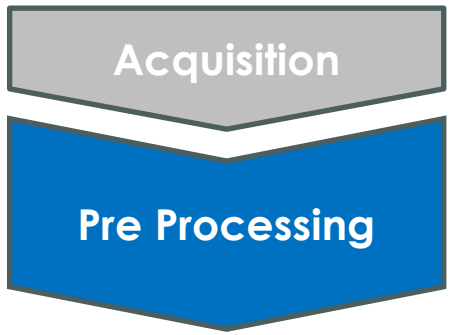
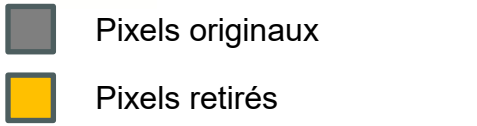
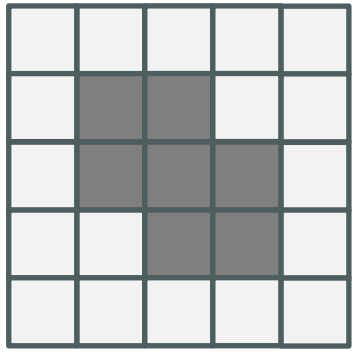


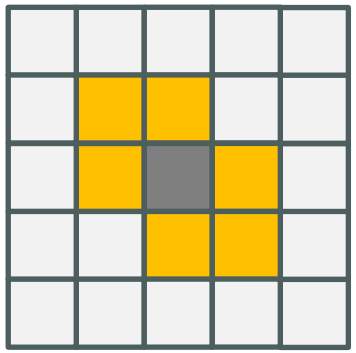
# Traitement d'images

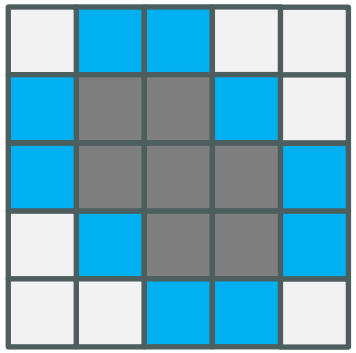
## Erosion / Dilatation





kernel

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

### Erosion

**Réduire le premier plan** en retirant progressivement les pixels le long des contours des objets

### Dilatation

**Étendre le premier plan** en ajoutant des pixels le long des contours des objets

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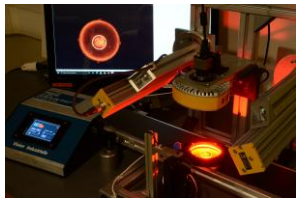
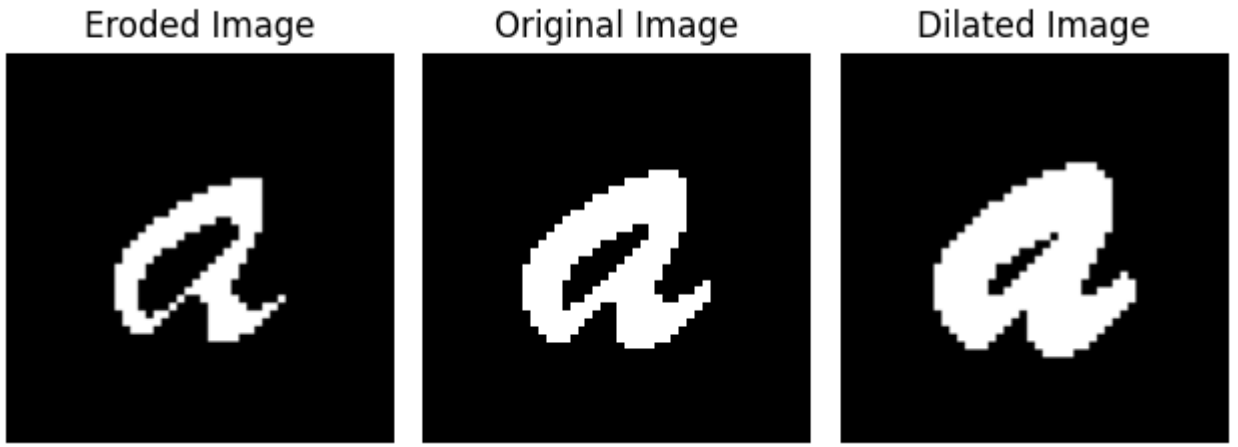


# Traitement d'images

## Erosion / Dilatation

Acquisition

Pre Processing




kernel

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

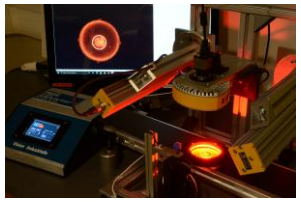
### Erosion

**Réduire le premier plan** en retirant progressivement les pixels le long des contours des objets

### Dilatation

**Étendre le premier plan** en ajoutant des pixels le long des contours des objets

INSTITUT d'OPTIQUE GRADUATE SCHOOL | LEnsE Laboratoire d'Enseignement Expérimental



# Traitement d'images

## Ouverture / Fermeture

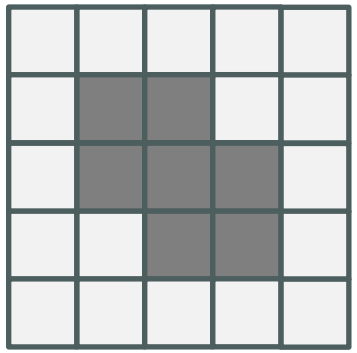
Acquisition

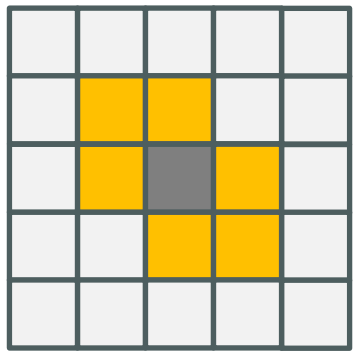
Pre Processing

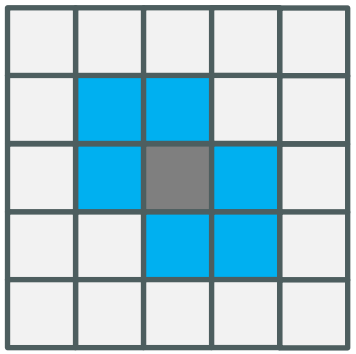
Original pixels

Removed pixels

Added pixels







Ouverture

Fermeture

**Erosion** puis **Dilatation**

Retire des petits objets

**Dilatation** puis **Erosion**

Remplit des petites zones

kernel

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

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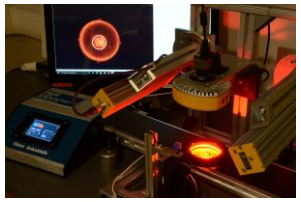
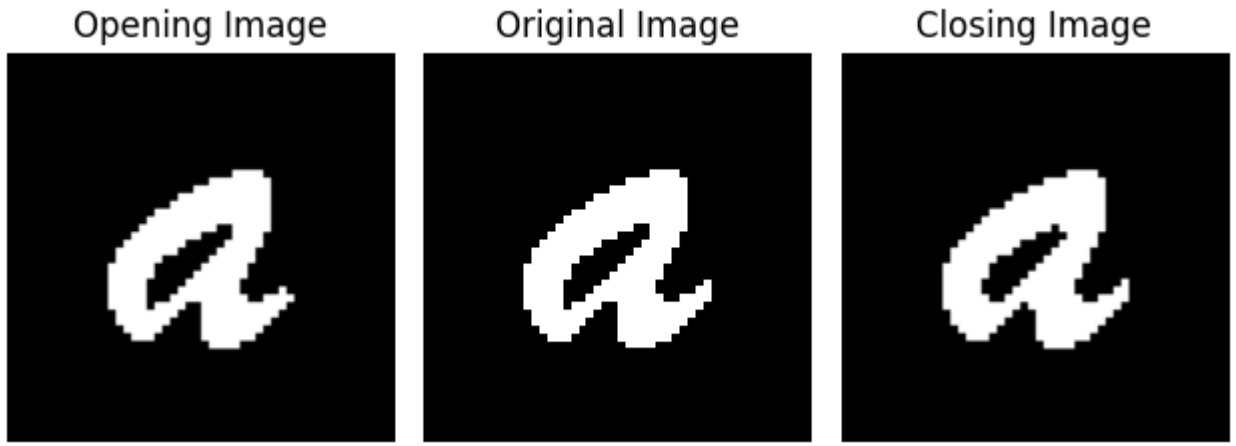


# Traitement d'images

## Ouverture / Fermeture

Acquisition

Pre Processing




kernel

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

### Ouverture

**Erosion** puis **Dilatation**

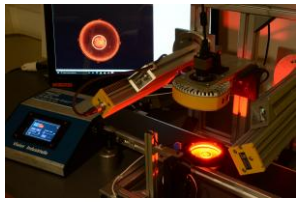
Retire des petits objets

### Fermeture

**Dilatation** puis **Erosion**

Remplit des petites zones

INSTITUT d'OPTIQUE GRADUATE SCHOOL | LEnsE Laboratoire d'Enseignement Expérimental

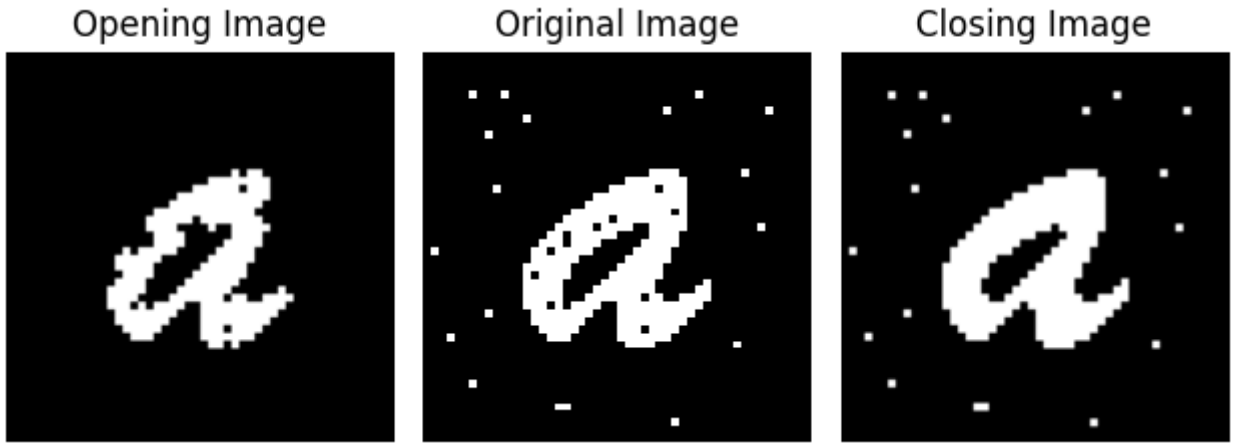


# Traitement d'images

## Ouverture / Fermeture

Acquisition

Pre Processing




kernel

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

### Ouverture

**Erosion** puis **Dilatation**

Retire des petits objets

### Fermeture

**Dilatation** puis **Erosion**

Remplit des petites zones

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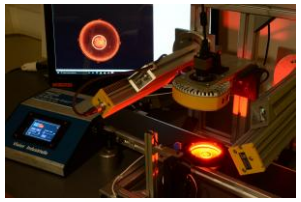
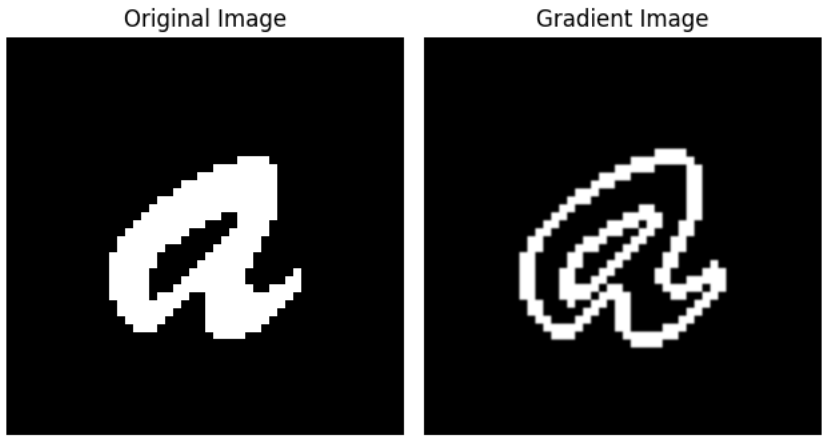


# Traitement d'images

## Gradient

- Acquisition
- Pre Processing
- Segmentation




kernel

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

### Gradient

**Difference** entre une **dilatation** et une **érosion**

*Classification des pixels :* **scène** *(background)* ou **objets** *(foreground) ?*

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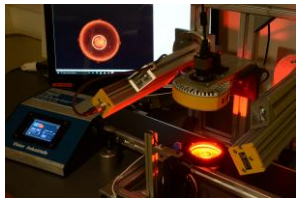


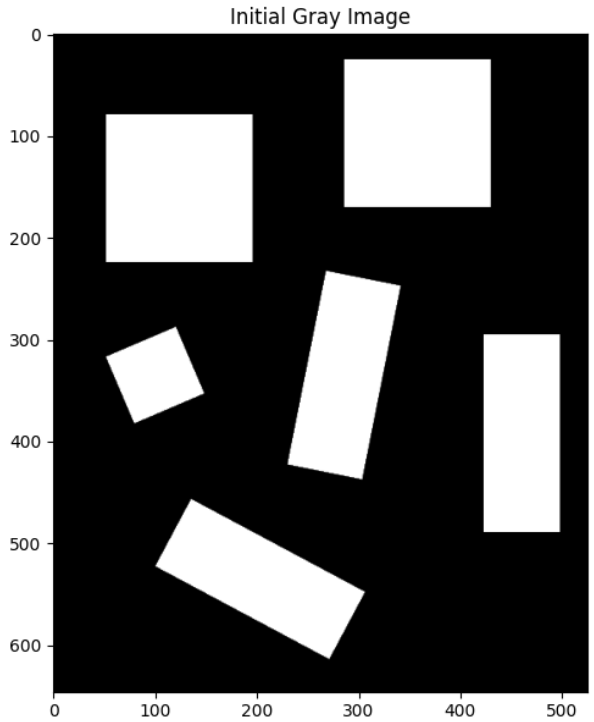
# Traitement d'images

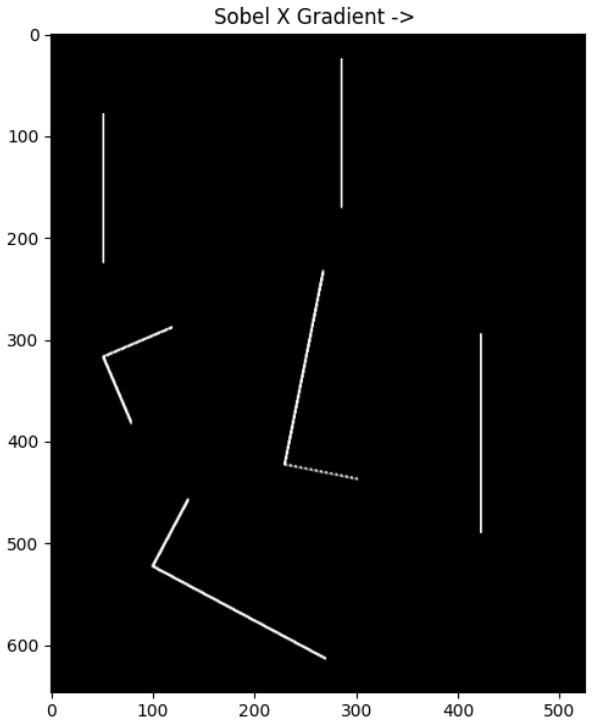
## Opérateur de Sobel

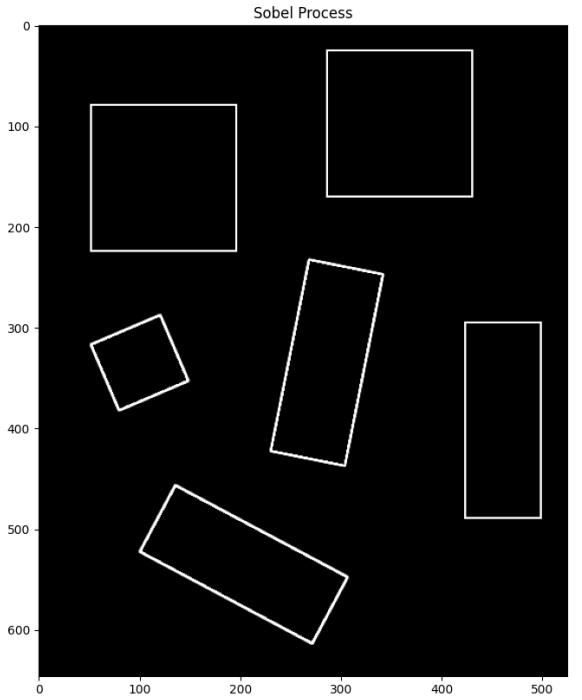
- Acquisition
- Pre Processing
- Segmentation

kernel

| | | |
|---|---|---|
| -1 | 0 | 1 |
| -2 | 0 | 2 |
| -1 | 0 | 1 |



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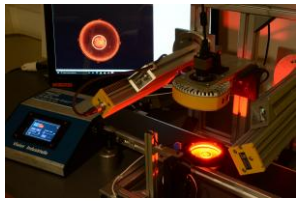
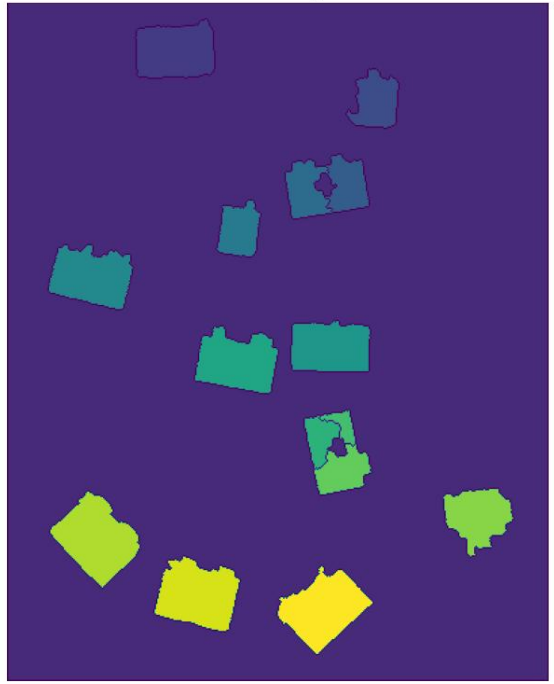


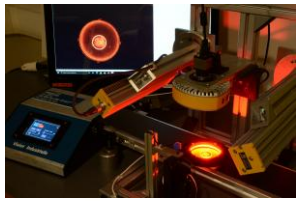
# Traitement d'images

## Méthode de Watershed

- Acquisition
- Pre Processing
- Segmentation
- Extraction d'informations
- Classification


INSTITUT d'OPTIQUE GRADUATE SCHOOL | LEnsE Laboratoire d'Enseignement Expérimental



# Traitement d'images

## Méthode de Watershed

- Acquisition
- Pre Processing
- Segmentation
- Extraction d'informations
- Classification