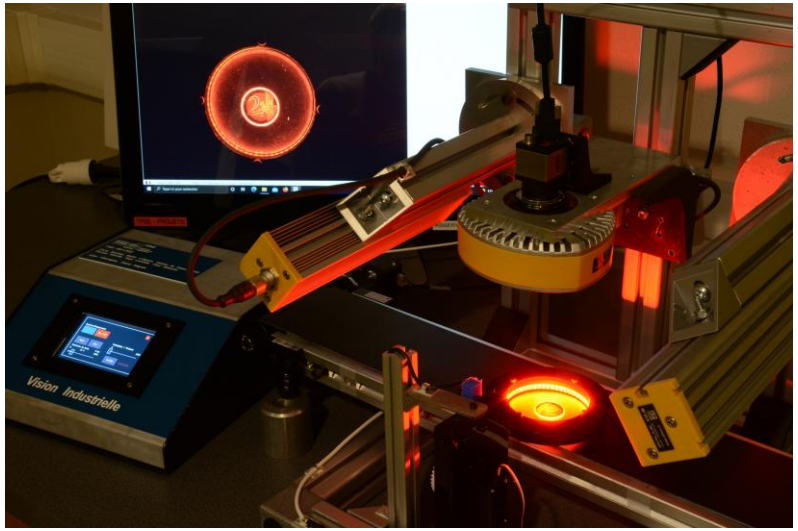
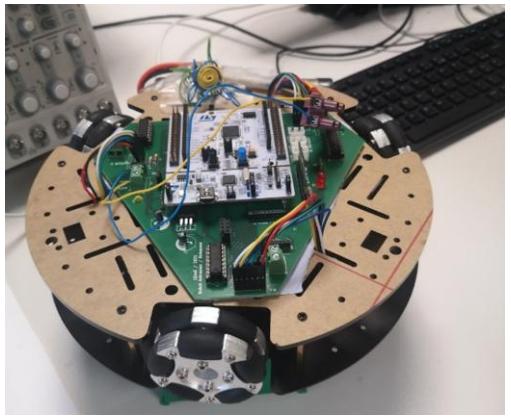
INSTITUT d'OPTIQUE GRADUATE SCHOOL | LEnsE Laboratoire d'Enseignement Expérimental

Interfaçage Numérique

Vision Industrielle

Julien VILLEMEJANE





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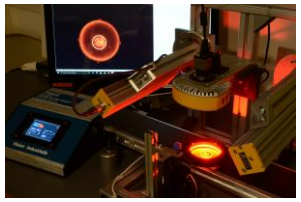

Vision Industrielle

Machine Vision

Système basé sur un **système imageant** permettant d'**automatiser les procédés d'inspection** de produits

► **Prendre une décision**

Contrôle Qualité / Tri d'objets

- Détecter des défauts ou irrégularités
- Vérifier l'uniformité de surface
- Compter ou/et trier des objets

Gain en efficacité et en répétabilité

- Inspection en temps réel et à vitesse élevée
- Opérations en continu

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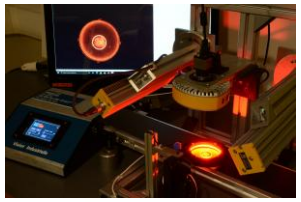
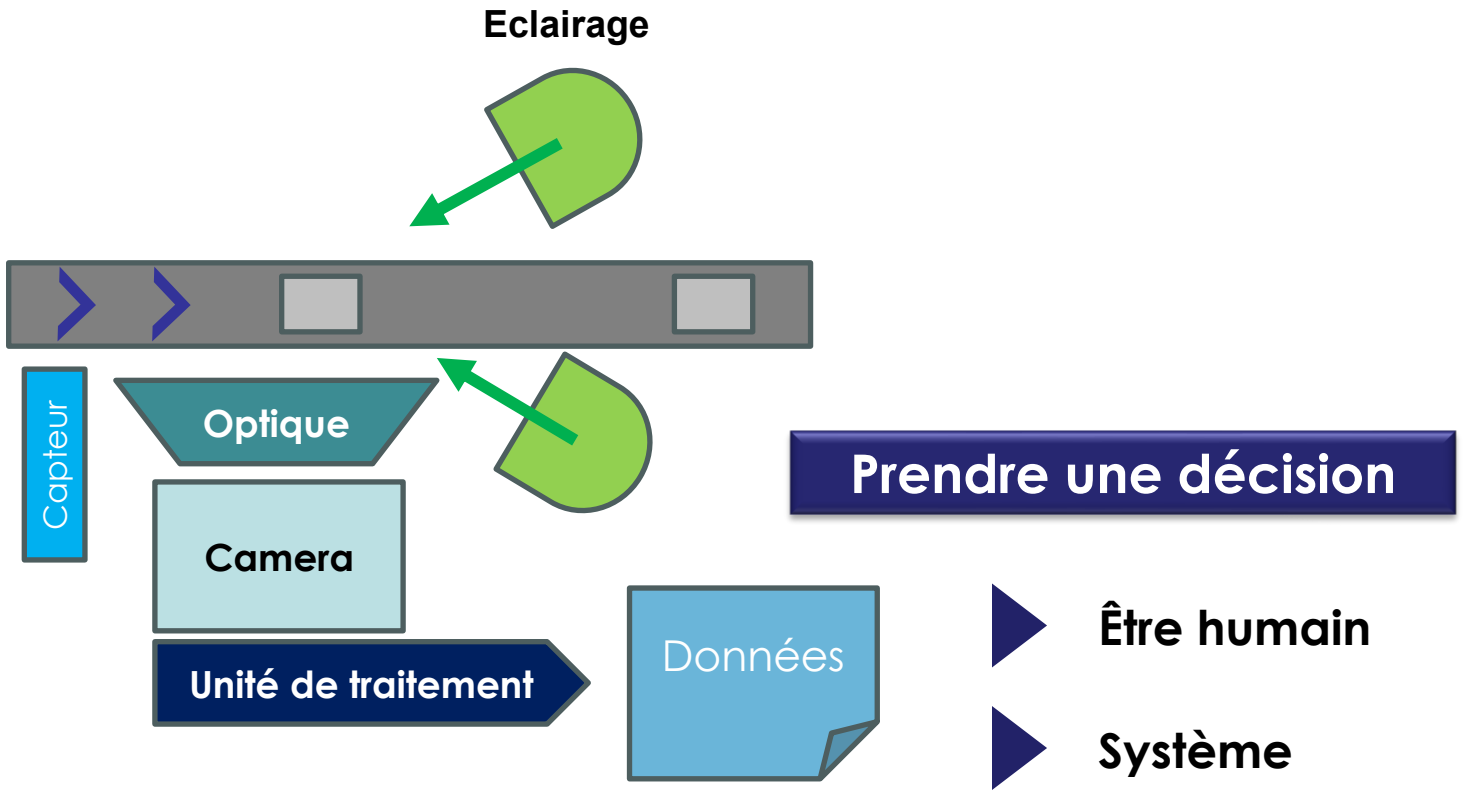


Vision Industrielle

Eléments constitutifs



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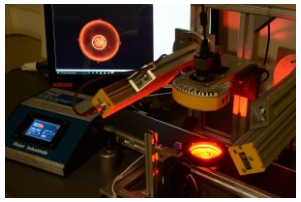
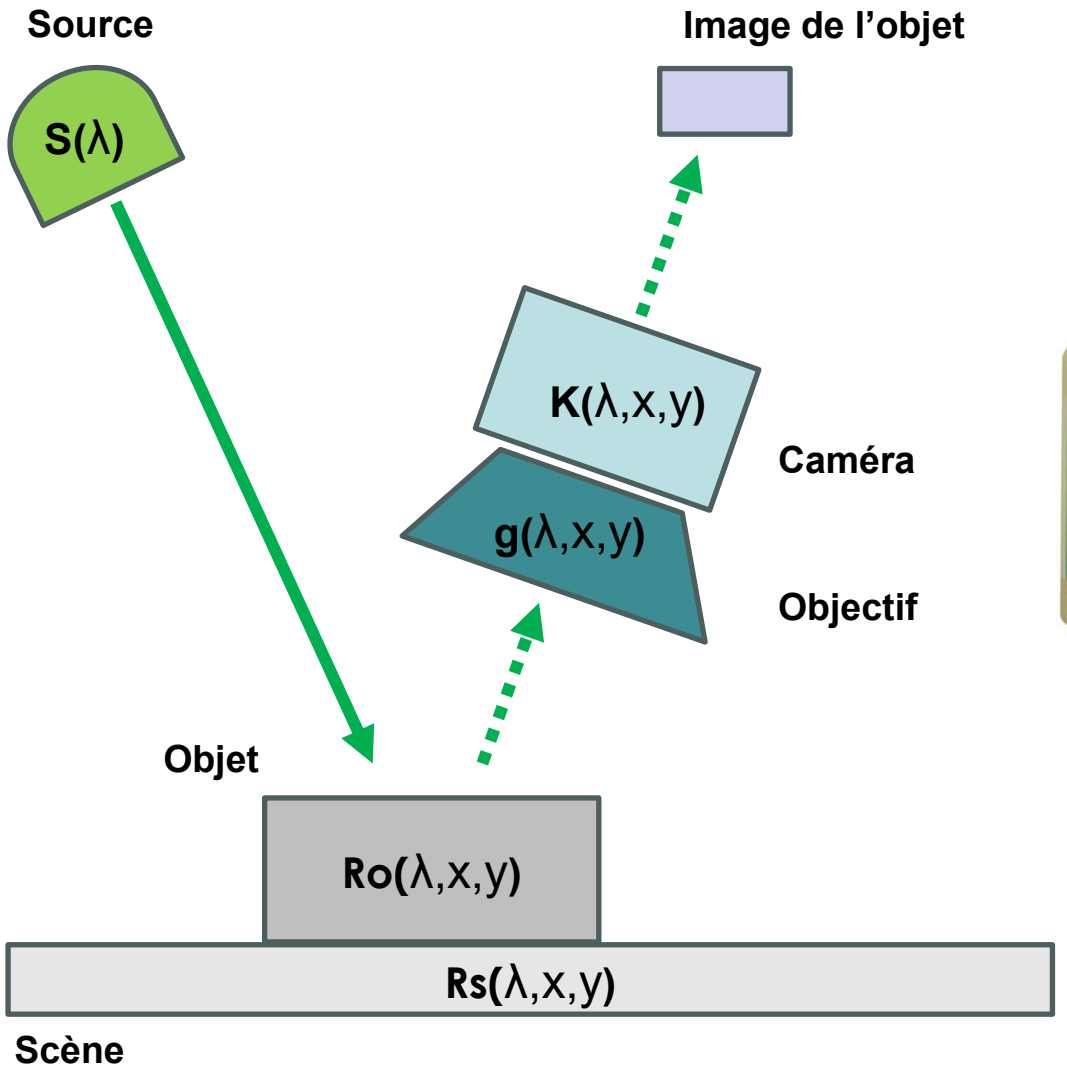
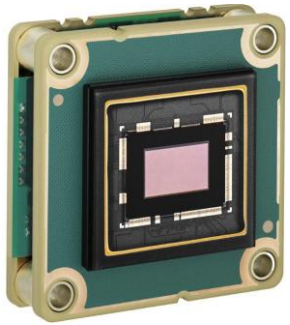


Vision Industrielle

Modélisation de la chaine





Basler Sensor / Mouser

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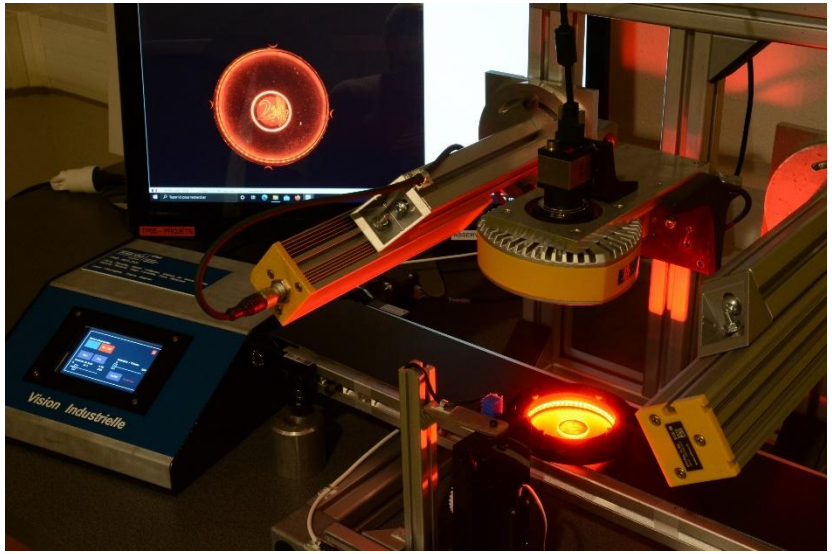
Objets / Sources

Eclairage / Colorimétrie



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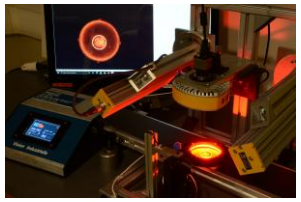
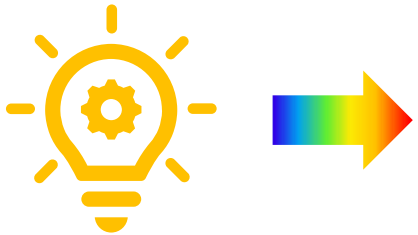


Sources

Sources primaires

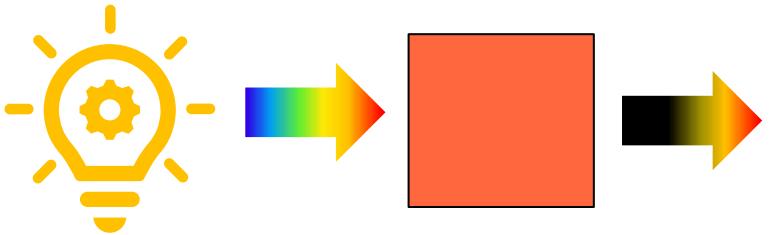
Produisent leur propre lumière



Caractérisées par leur spectre d'émission

Sources secondaires

Diffusent la lumière produite par une source primaire



Caractérisées par le spectre de l'illuminant et leur spectre en réflectance

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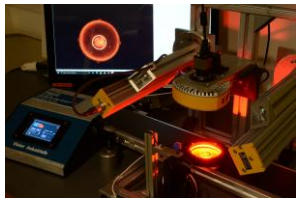
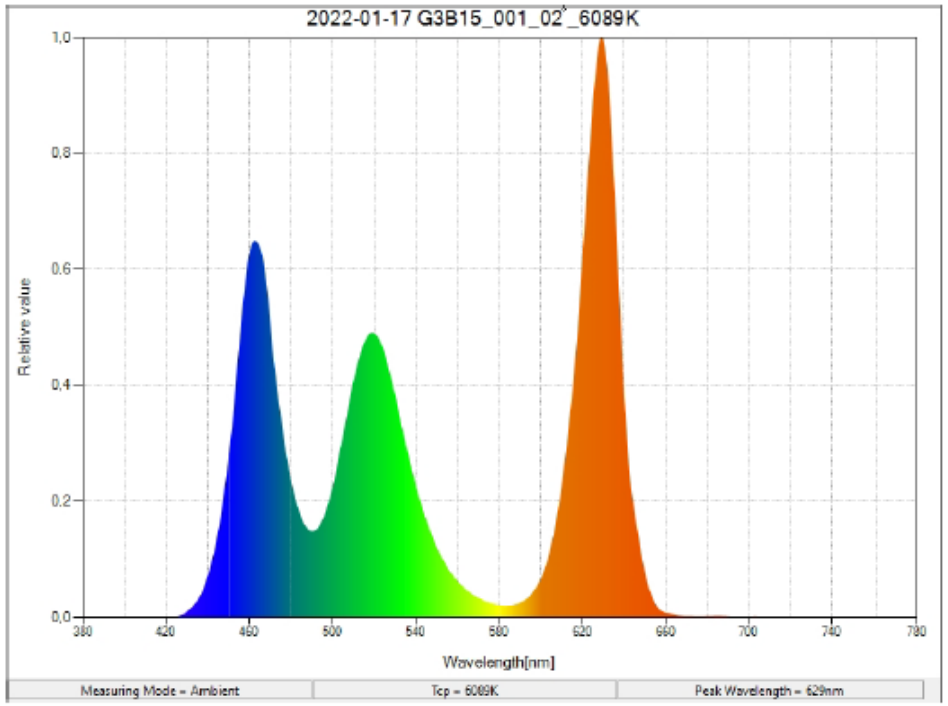
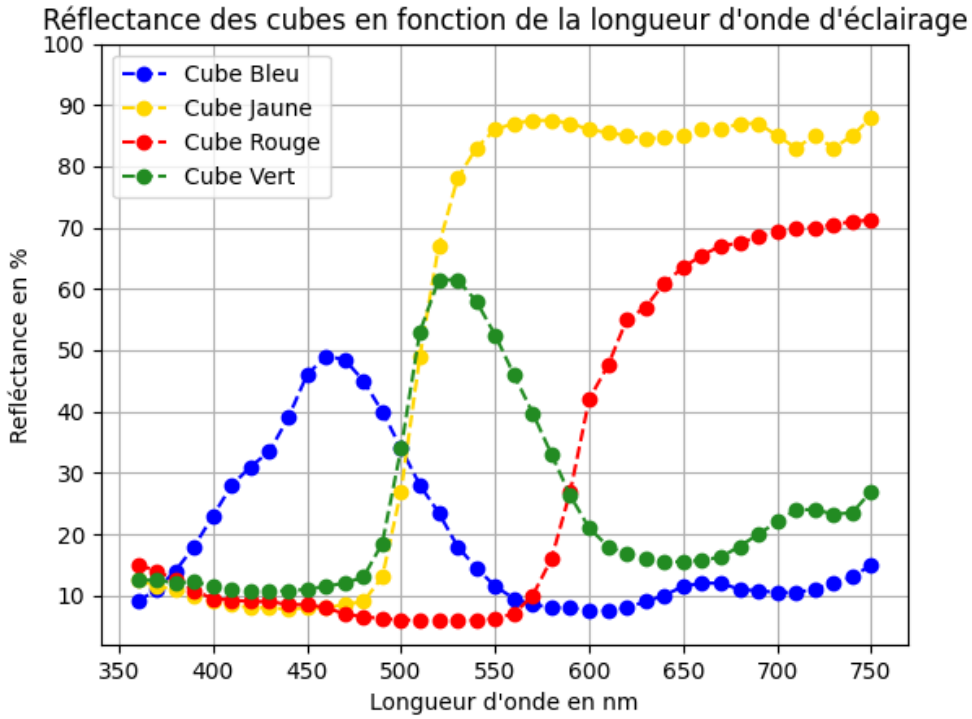


Sources

Spectre d'émission



Réflectance



Source Effilux Ring RGB

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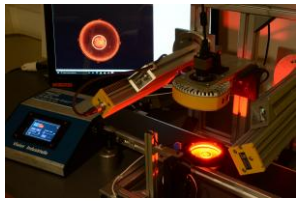

Eclairage

Uniformité de l'éclairage

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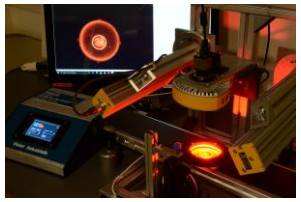
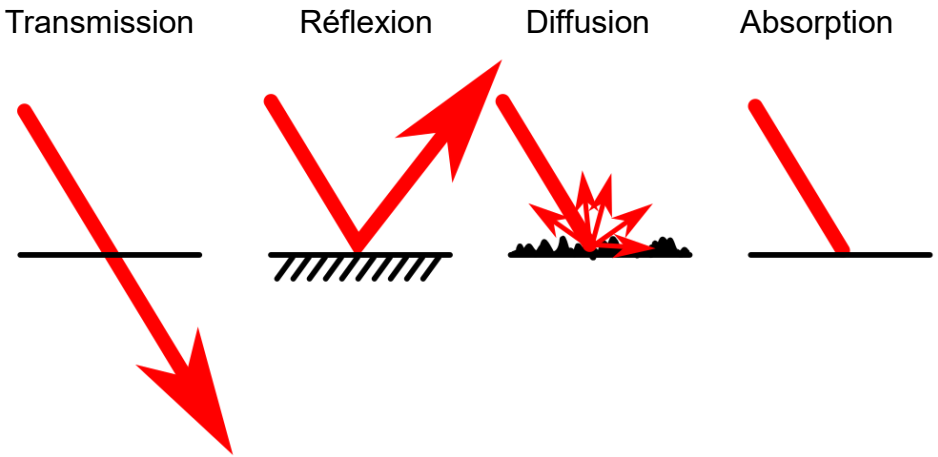
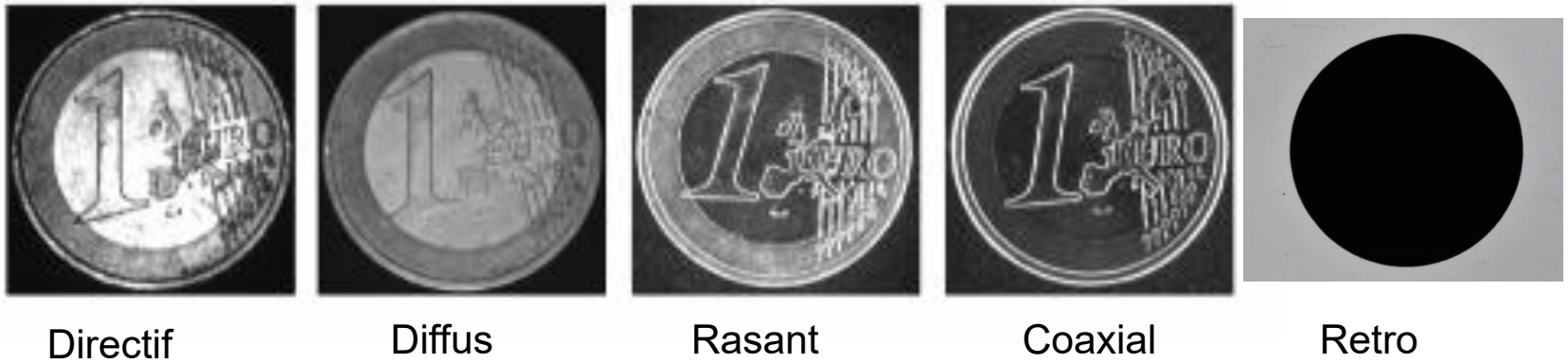


Eclairage

Impact du type d'éclairage / Nature des objets





Directif | Diffus | Rasant | Coaxial | Retro

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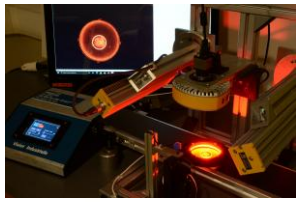

Colorimétrie

Image prise par un capteur optique
(sans balance des blancs)

Image vue par un humain
(grâce à l'adaptation chromatique)

▶ Fairchild, *Color Appearance models*

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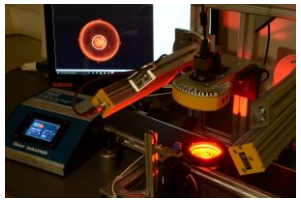
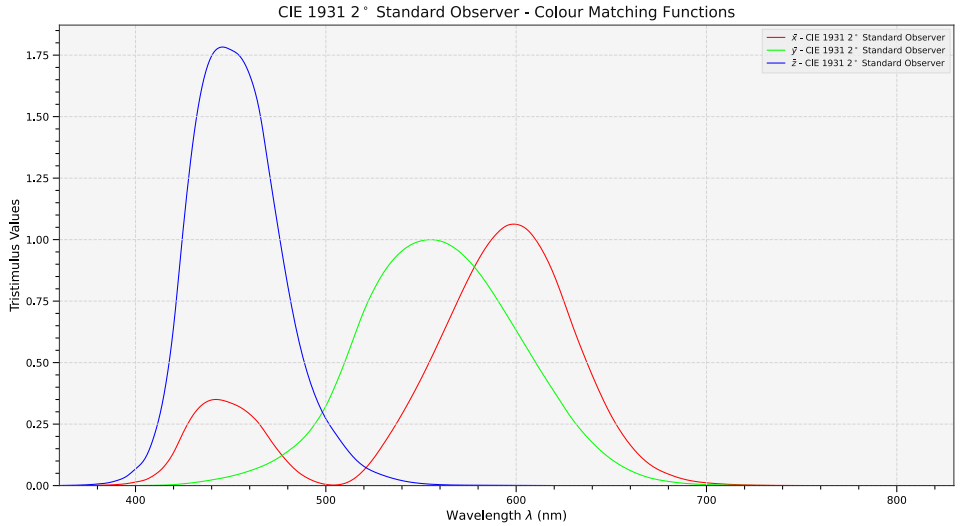
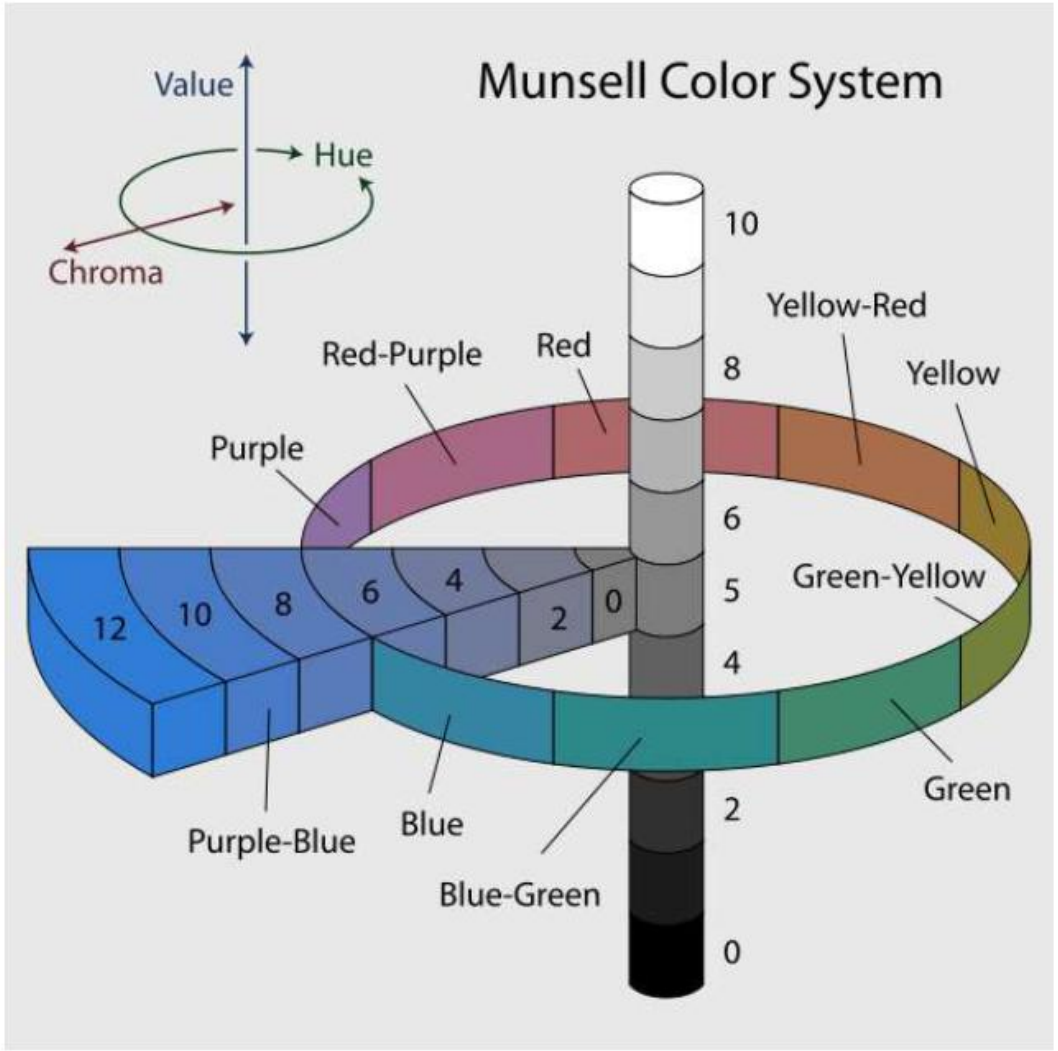


Colorimétrie



$$K_m = 683\ lm/W$$

$$\begin{cases} X = K_m \int_0^\infty \bar{x}(\lambda) L_{e,\lambda}(\lambda) d\lambda \\ Y = K_m \int_0^\infty \bar{y}(\lambda) L_{e,\lambda}(\lambda) d\lambda \\ Z = K_m \int_0^\infty \bar{z}(\lambda) L_{e,\lambda}(\lambda) d\lambda \end{cases}$$



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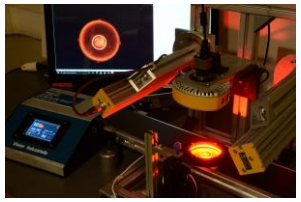
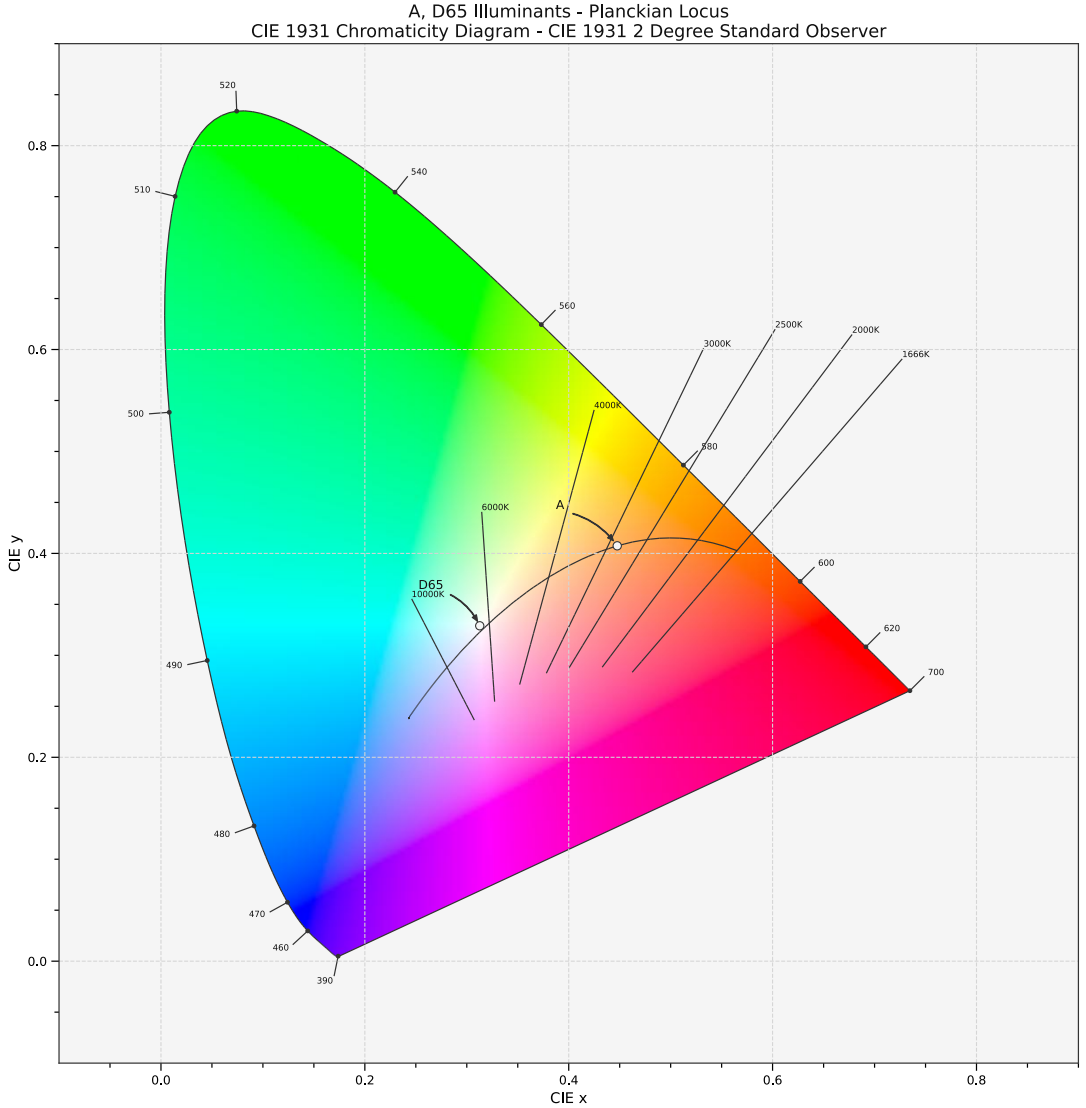


Colorimétrie

Diagramme de chromaticité CIE 1931 xy

$$\begin{cases} x = \dfrac{X}{X+Y+Z} \\ y = \dfrac{Y}{X+Y+Z} \end{cases}$$

Les coordonnées (x,y) définissent la couleur de la source échantillon



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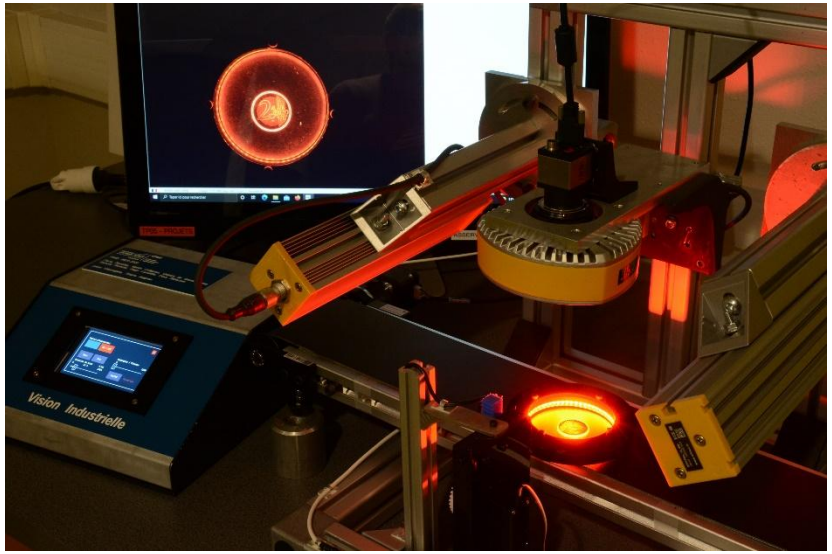
Objectif optique

Créer une image exploitable



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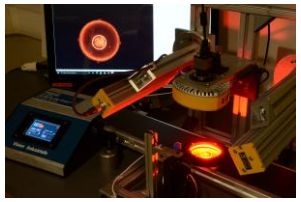

Objectif optique

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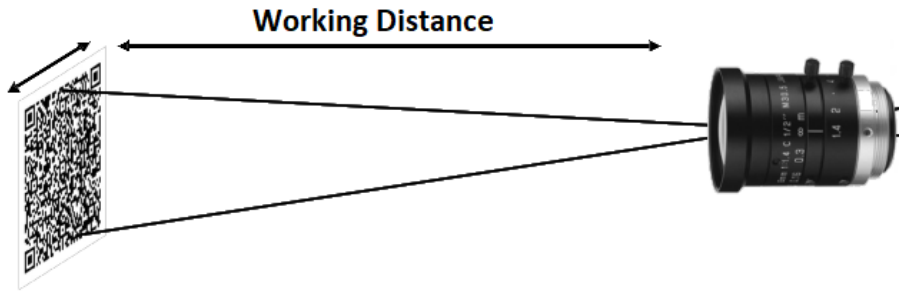

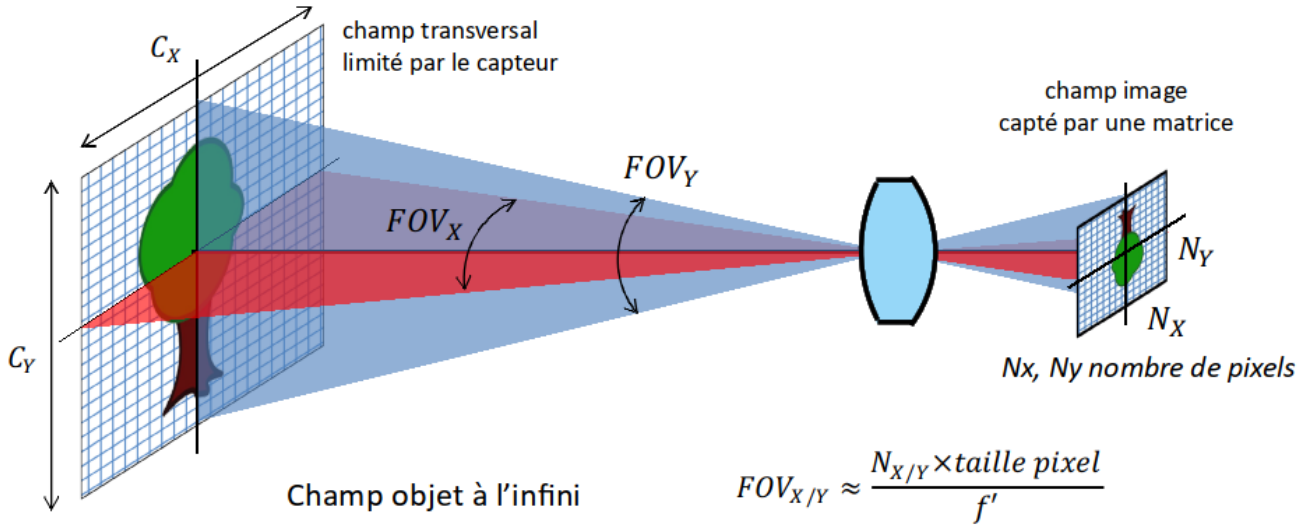

$$FOV_{X/Y} \approx \frac{N_{X/Y} \times taille\ pixel}{f'}$$

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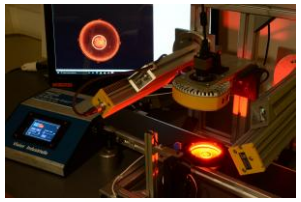
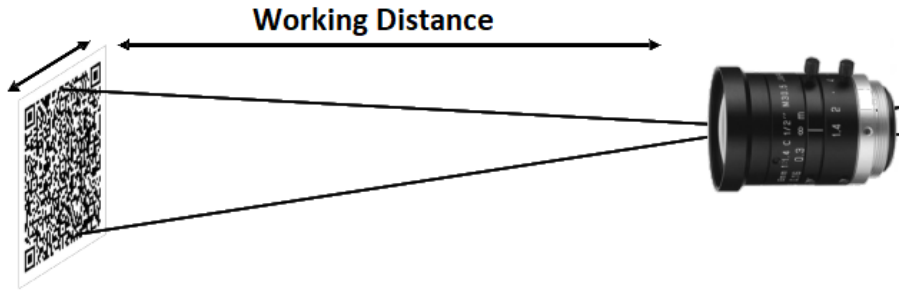
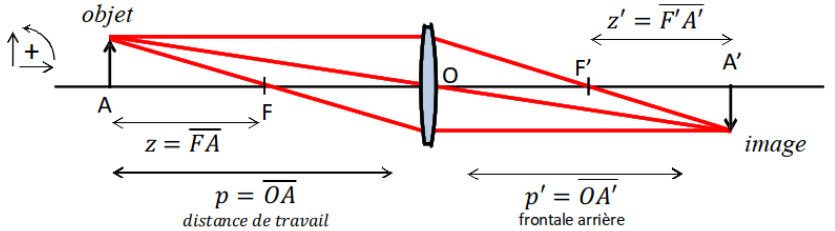


Objectif optique

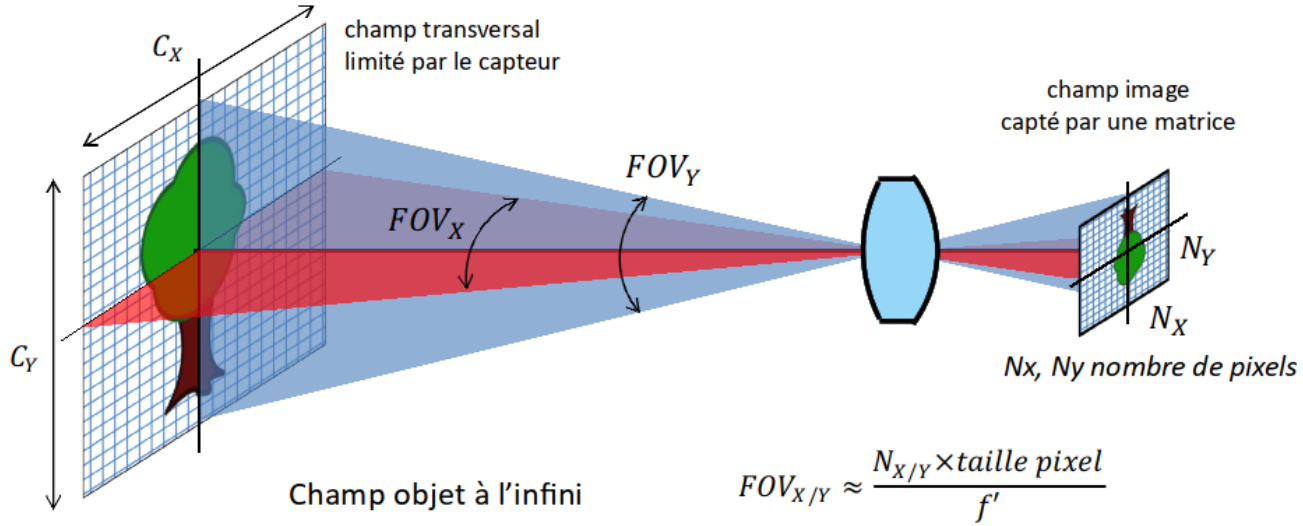
Créer une image





taille image
grandissement transversal
$$g_y = \frac{y'}{y} = \frac{p'}{p} = -\frac{z'}{f'} = -\frac{f}{z}$$

grandissement longitudinal
$$g_z = \frac{\delta p'}{\delta p} = (g_y)^2$$



$$FOV_{X/Y} \approx \frac{N_{X/Y} \times taille\ pixel}{f'}$$

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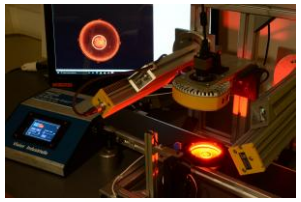

Objectif optique

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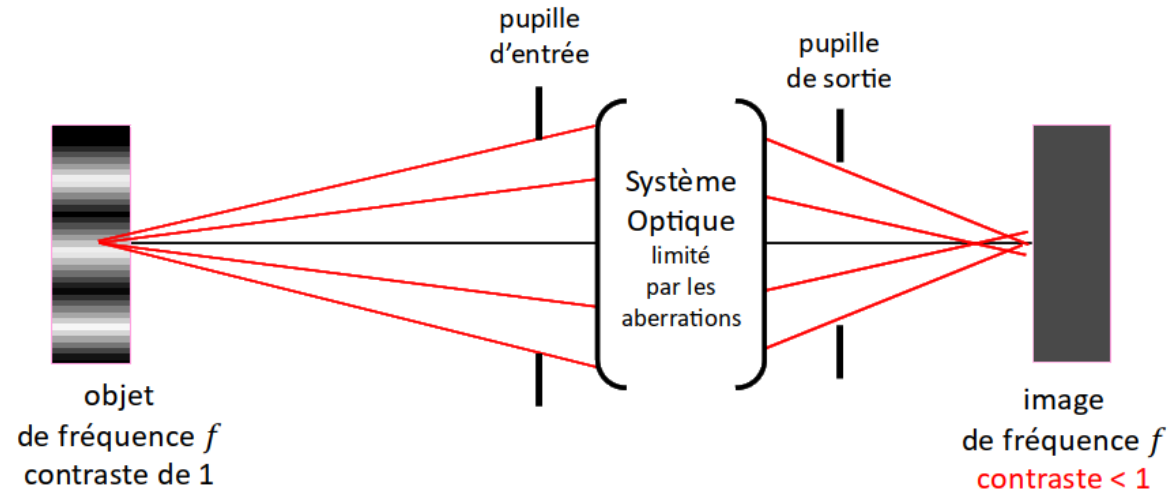

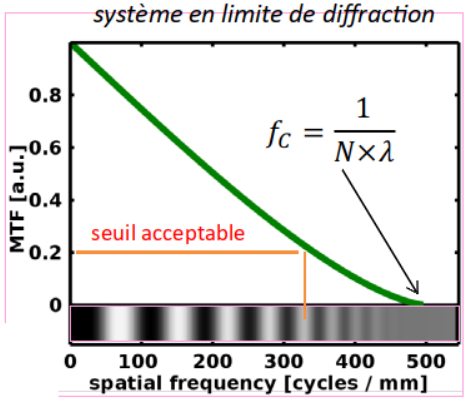

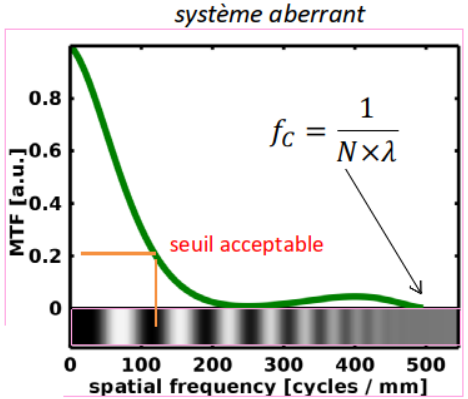

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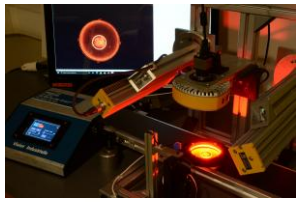

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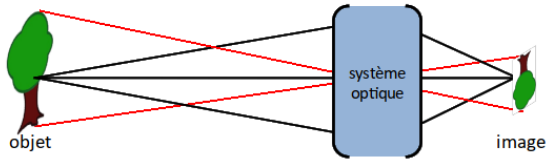
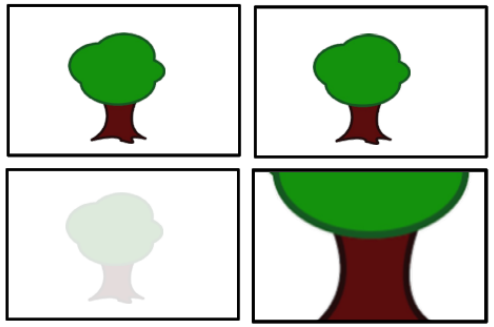
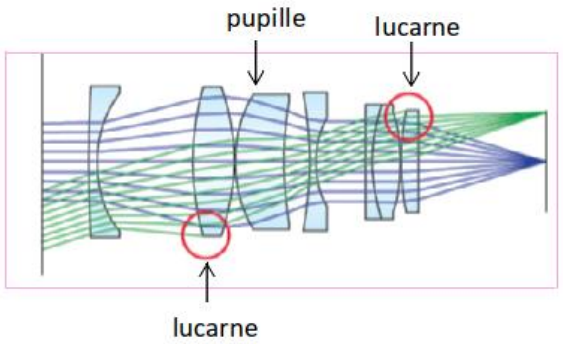
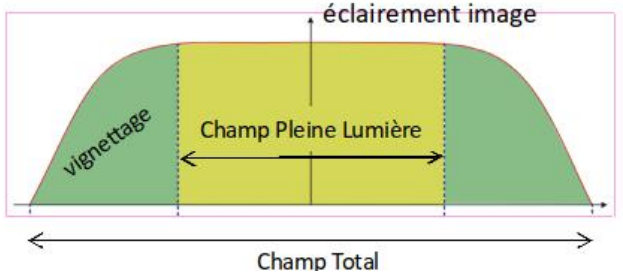


Ouverture *flux collecté*

Champ *taille max objet capté*







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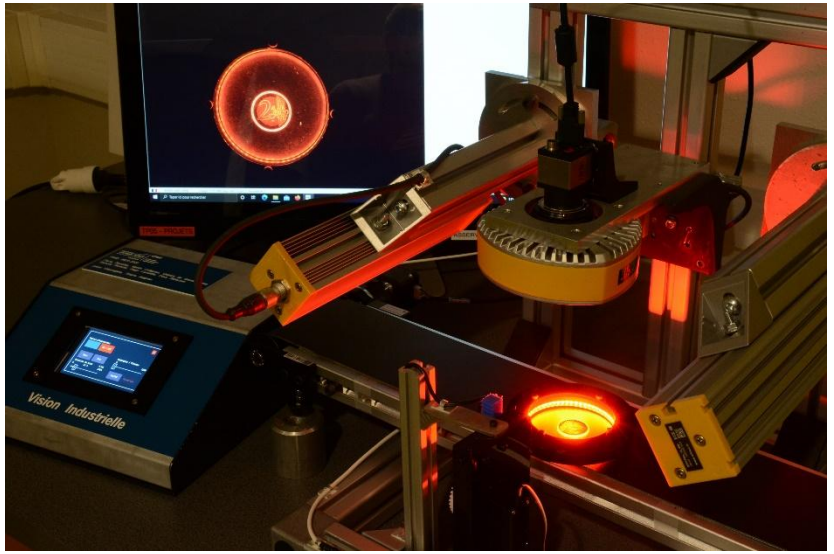
Caméra numérique

Echantillonnage / Quantification
Colorimétrie



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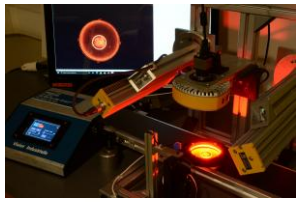
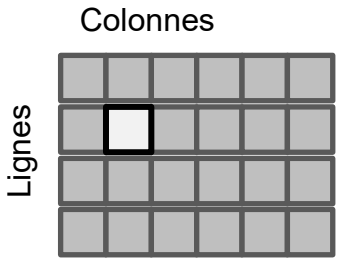


Caméra numérique

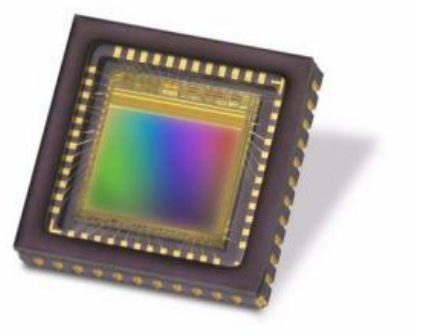
Matrice de pixel



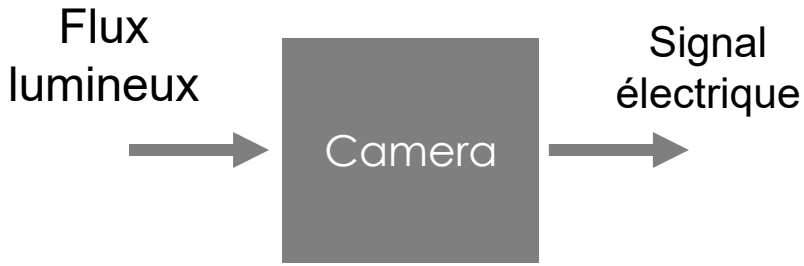
Camera

Système qui transforme un **flux lumineux** en un **signal électrique mesurable**

IDS UI-1240SE-C-HQ



e2v sensor EV76C560ACT



Taille d'un pixel de l'ordre de 2 à 10 um

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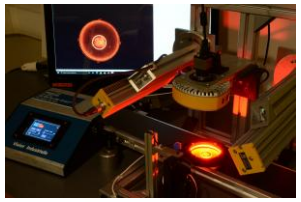
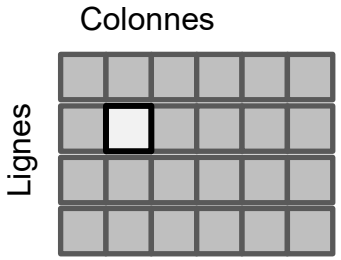
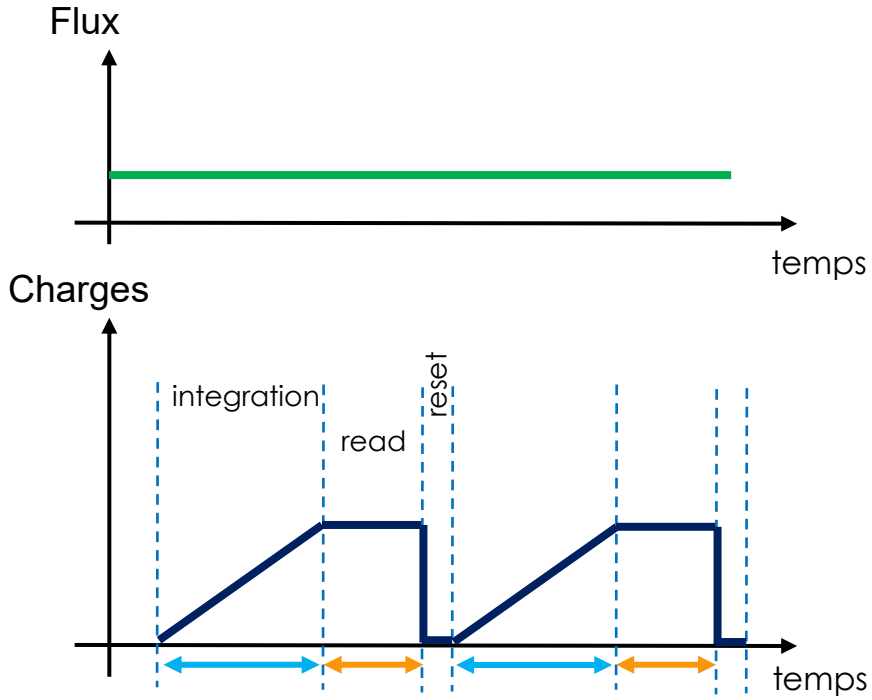


Caméra numérique

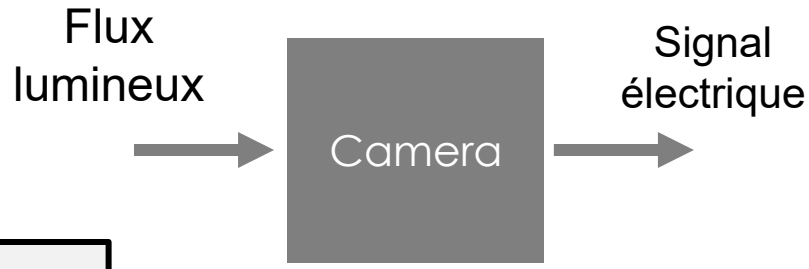
Matrice de pixel

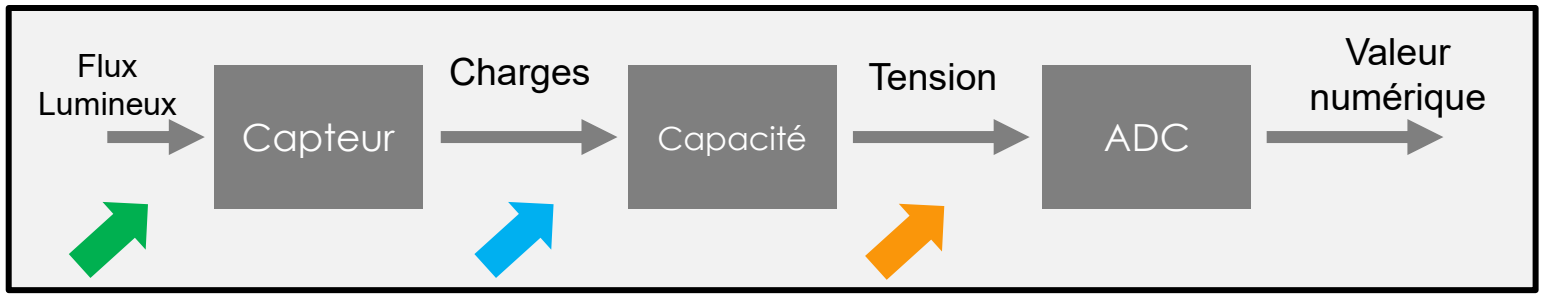




Camera

Système qui transforme un **flux lumineux** en un **signal électrique mesurable**





Taille d'un pixel de l'ordre de 2 à 10 um

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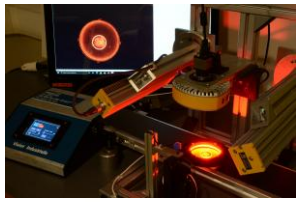
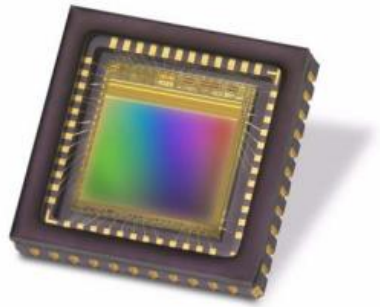
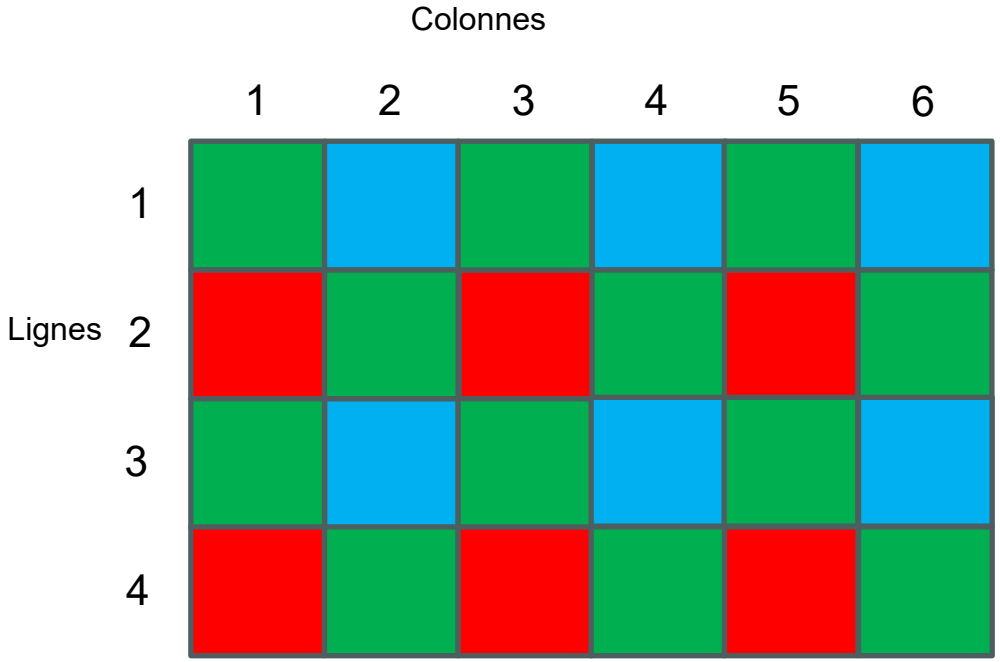


Caméra numérique

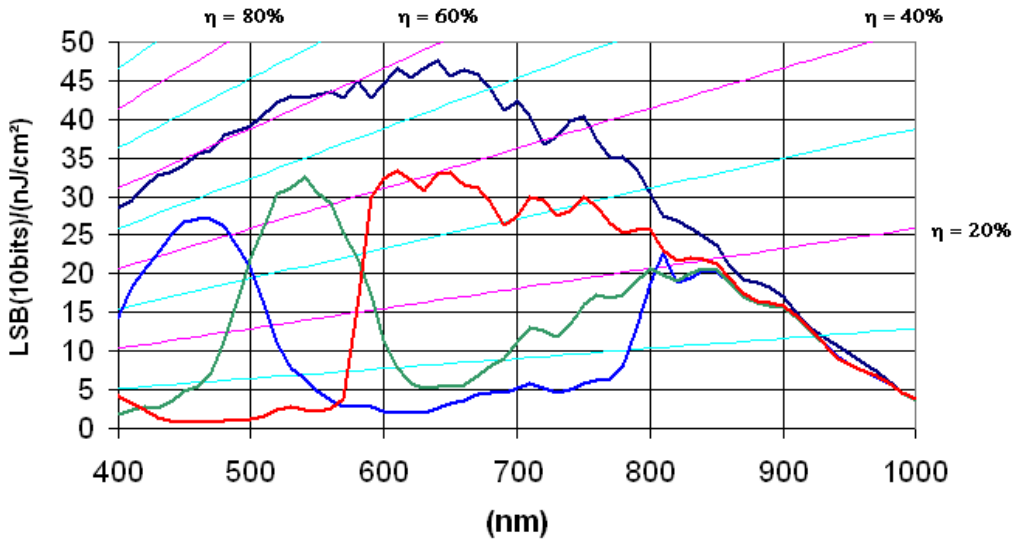
Réponse spectrale



e2v sensor EV76C560ACT



Matrice de Bayer



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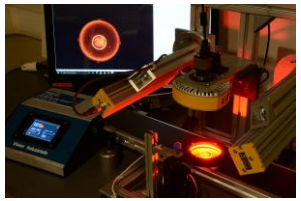
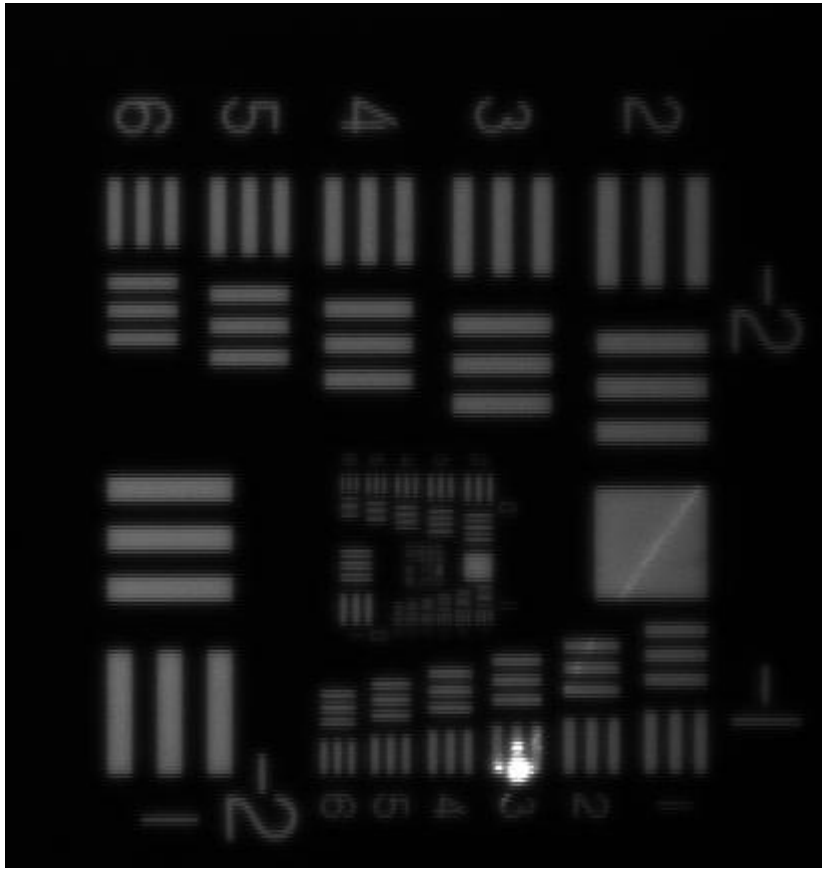


Vision Industrielle



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Traitement d'image

Pré-traitement / Segmentation / Classification