FOR ALL (30 minutes):

Consider the following line scan cameras: **Device "1":** sensor of **4096 points**, each point of **2.6 micron * 2.6 micron**, able to acquire up to **20.000 lines per second**, price **800 euro**. **Device "2":** sensor of **2048 points**, each point of **4.2 micron * 4.2 micron**, able to acquire up to **30.000 lines per second**, price **450 euro**.

Define **two setups** for analysing objects having a **surface of 3 m * 15 m** at a resolution of **at least 1 pixel / 500 micron** (both along X and along Y): **setup 1** based on Devices like the "1", **setup 2,** based on Devices like the "2".

Which is the **preferable setup, in case we wish save money**?

Which is the **preferable setup in case we wish the fastest acquisition period**?

Consider now only the setup 2:

- **How many objects** can be analysed in 1 hour?
- **And at which distance from the object** the camera should be located mounting a lens having focal **length of 50 mm**?
- **Which is the smallest size of a detectable defect**, if your software needs at least **10 pixel * 10 pixel** for a correct processing?

DEVICE 1

4096 points

2,6 μm * 2,6 μm

20.000 lps

800 €

DEVICE 2

2048 points

4,2 μm * 4,2 μm

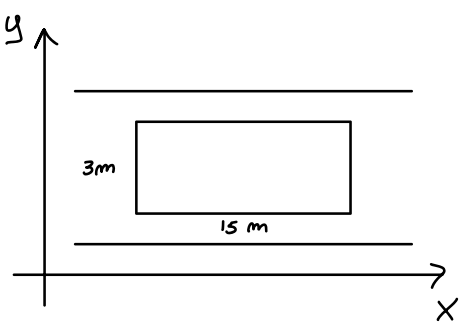
30.000 lps

450 €

DIM OGG

3m * 15m

ris min = $\frac{1\,px}{500\,\mu m}$



$r = \frac{1}{500} = 2 \cdot 10^{-3} \frac{px}{m} = 2 \frac{px}{mm}$

DEVICE 1

lungo y → $\frac{4096}{3m} = \frac{4096}{3000} = 1{,}36 \frac{px}{mm}$ < $r = 2 \frac{px}{mm}$

=> del device 1 ne servono almeno 2 per raggiungere i $2 \frac{px}{mm}$

per un prezzo tot di: 800€ · 2 = 1600 €

risoluzione con 2 telecamere: $r = \frac{2 \cdot 4098}{3000} = 2{,}73 \frac{px}{mm}$

DEVICE 2

lungo y -> $\frac{2048\ px}{3000\ mm} = 0{,}68 \frac{px}{mm} < r$

=> del device 2 ne servono almeno 3 per raggiungere i $2 \frac{px}{mm}$
per un prezzo tot di: $450€ \cdot 3 = 1350€$

risoluzione con 3 telecamere: $r = \frac{3 \cdot 2048}{3000} = 2{,}05 \frac{px}{mm}$

1. Il setup più economico è il 2

2. Il setup 1 acquisice a 20.000 fps => $V = \frac{20.000}{2 \frac{px}{mm}} = 10000 \frac{mm}{s}$ | $= 10 \frac{m}{s}$

Il setup 2 acquisisce a 30.000 fps => $V = \frac{30.000}{2 \frac{px}{mm}} = 15 \frac{m}{s}$

Perciò $15 \frac{m}{s} > 10 \frac{m}{s}$ e il setup più veloce è il secondo.

3. $1h = 3600s$

$s = v \cdot t = 15 \frac{m}{s} \cdot 3600\ s = 54.000\ m$

=> $n.\ oggetti = \frac{54.000\ m}{15\ m} = 3600$ oggetti in 1 h

4. $WD = \frac{f \cdot FOV}{dim\ sens} = ?$ $\quad f = 50\,mm \quad FOV = 3\,m = 3000\,mm$

$dim\ sens = 3 \cdot 2048 \cdot 4{,}2 \cdot 10^{-3} = 25{,}8\,mm$

$WD = \frac{50 \cdot 3000}{25{,}8} = 5{,}8\,m$

5. smallest defect size

$\frac{10\,px}{r_{dev\,2}} = \frac{10\,px}{2{,}04\,\frac{px}{mm}} = 4{,}88\,mm$