IP Cameras: Motion blur and wide angle lens distortions

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Prepared for ***All-over-IP*** conference
21 ~ 23 November 2018
Moscow

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Cameras have some important parameters…

Some cameras parameters are chosen by design:

- Resolution
- Low light performance
- Dynamic range
- S/N
- Images per second
- Compression quality

But there are additional factors…

- **Camera internal settings**
  - Sensor resolution
  - Compression (Mb/s, GOPs)
  - Electronic exposure
  - WDR
  - AGC
- **Optics**
  - Resolution
  - Focal length
  - F-stop (MI, AI)
  - Optical distortion
  - Flare
  - Projected circle

- **Environmentals:**
  - Temperature
  - Humidity
  - Vibrations
  - Position relative to light
  - Housing
  - EMI

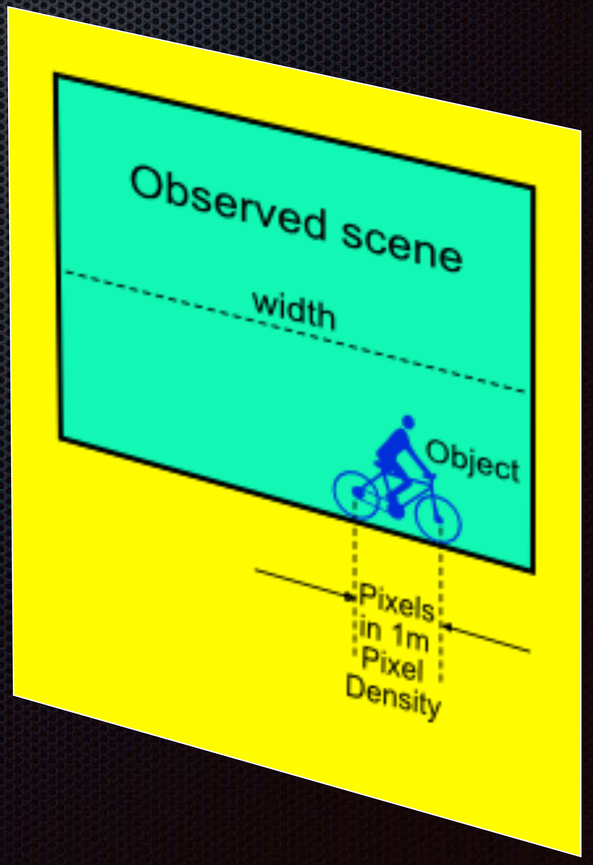
Testing lab compliant with the latest standards

Pixel Density

A new definition of picture details was introduced with IEC 62676-4 - the Pixel Density. Pixel Density could apply and be used on **any sensor resolution**.

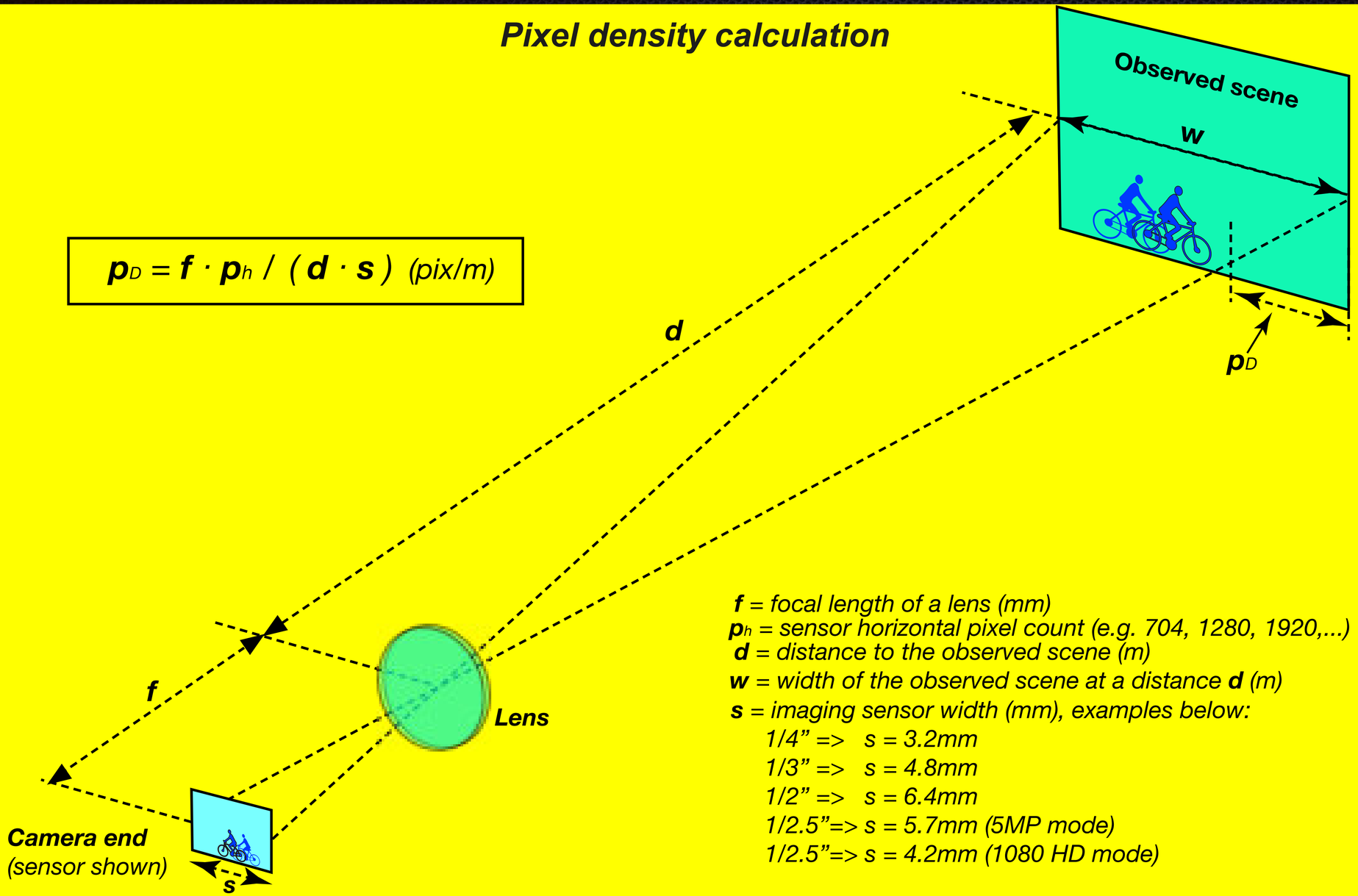
Pixel Density indicates ***how many pixels are captured on a camera sensor from one metre width at the observed scene plane (pix/m).***

The more pixels across one metre, the better clarity of the observed object would be.
Naturally, we are assuming a good lens, focused correctly and there is sufficient light on the object of interest.



Pixel density calculation

$$p_D = f \cdot p_h \,/\, (d \cdot s) \quad (pix/m)$$

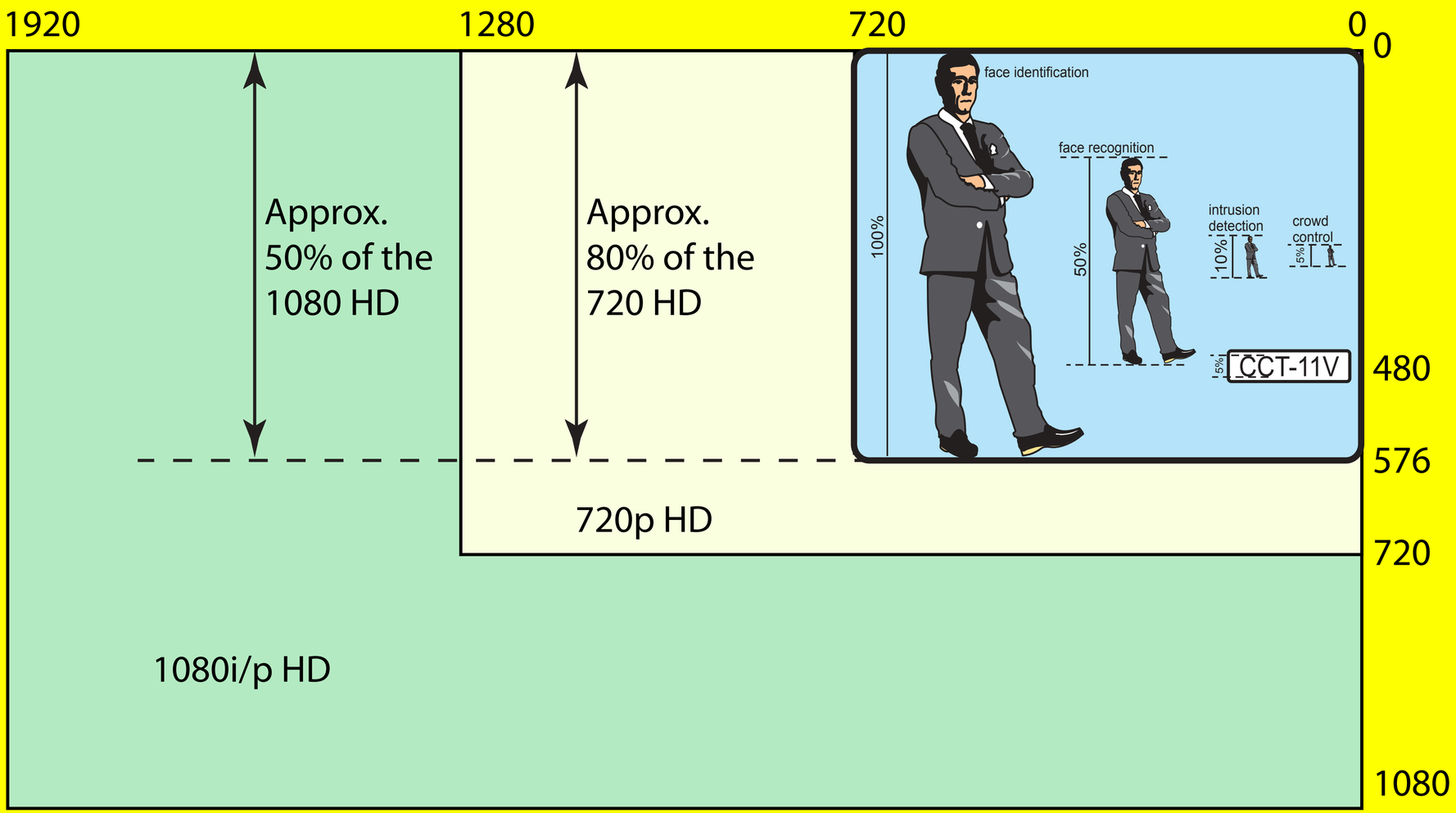


f = focal length of a lens (mm)
p_h = sensor horizontal pixel count (e.g. 704, 1280, 1920,...)
d = distance to the observed scene (m)
w = width of the observed scene at a distance **d** (m)
s = imaging sensor width (mm), examples below:

- 1/4" => s = 3.2mm
- 1/3" => s = 4.8mm
- 1/2" => s = 6.4mm
- 1/2.5"=> s = 5.7mm (5MP mode)
- 1/2.5"=> s = 4.2mm (1080 HD mode)

Drawing, maths and formulas by V.Damjanovski © 2014~2017

Face Identification standards



Face recognition and identification in SD and HD

Pixel Density math

PAL signal is composed of **576 active TV lines** = 576 vertical pixels.

If a person height is 1.7m => 576 / 1.7 = 340 pix/m

To compensate for compression losses, we suggest **350 pix/m**.

An average head size occupies around 15% of person's height.

576 x 0.15 = 86.4 pixels. We may round this to 90 pixels for head size.

So, one can say that with Pixel Density of **350 pix/m** at the object plane it should be possible to **positively identify a face**.

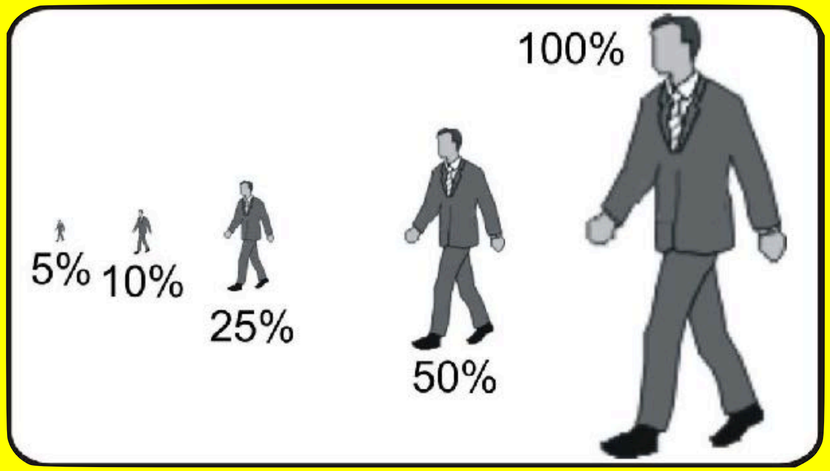
The IEC 62676-4 has slightly different maths, yielding **250 pix/m**.

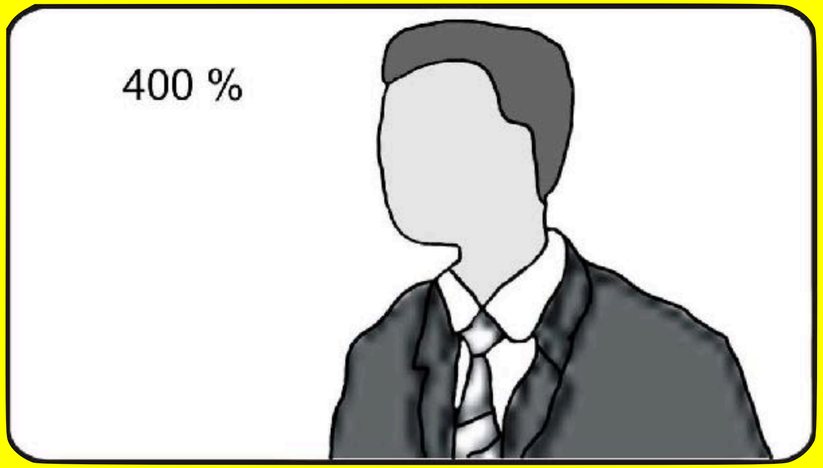
The IEC 62676-4 standards

All percentages refer to analogue PAL screen height (576TVL=576pix):

- 5% = **Monitor** crowd (person=30pix)
- 10% = **Detect** intrusion (person=60pix)
- 25% = **Observe** (person=144pix)
- 50% = **Recognise** (p=288pix h=44pix)
- 100% = **Identify** (p=576pix h=87pix)
- 400% = **Inspect** (h=348pix)

The same number of pixels would be required even with HD or 4k cameras.





Camera: Sony alpha 7RII
FF sensor = (36mm x 24mm)
Lens = 24mm
Distance = 20m
Pixel Density = 64 pix/m
Detect (35) < PD < Observe (88)

64 pix/m at 20m (HD=1920x1080)

Camera: Sony alpha 7RII
FF sensor = (36mm x 24mm)
Lens = 24mm
Distance = 10m
Pixel Density = 128 pix/m
Face Recognition (IEC 62676-4)

128 pix/m at 10m (HD=1920x1080)