

Automatic Face Detection example

A FI manufacturer requires minimum 22 pixels between the eyes.

An average pupil distance is 65mm.

$$1000\text{mm} : 65\text{mm} = 15.38$$

$$15.38 \times 22\text{pix} = 338 \text{ pix/m}$$



This would be minimum required for this particular FI manufacturer to work.

This is almost exactly what is sufficient for Face Identification as per our testing and AS 4806.2

Licence Plate Recognition example

Around 30 pixels (5% of SD screen) are required for number plates recognition
For an Australian rear number plates, the numbers are 70mm high and front 50mm.

Rear plates pixel density:

$1000\text{mm}:70\text{mm}=14\times30\text{pix}=420\text{pix/m}$

Front plates pixel density:

$1000\text{mm}:50\text{mm}=20\times30\text{pix}=600\text{pix/m}$

An additional requirement would be for the motion blur to be minimal. Shorter exposure means a good camera, more light or flash. This also depends on the speed and angle of the moving vehicle. LP needs to be reflective if flash light is used.



Russian licence plates

Of course, the first requirements to find a licence plate in a video is to have one.

Russian number plates have certain dimensions.

The actual numbers height is = 79mm.

Again, similar to the previous example, and based on the 5% screen height standards, we get:

5% of 576 active lines => 30 pixels.

$1000\text{mm}/79\text{mm}=12.66 \times 30\text{pix}=\mathbf{380\text{pix/m}}$



Minimum required pixel densities for various objects

Targets	IEC 62676-4 (pix/m)	ViDi Labs / AS (pix/m)
Monitor / Crowd control	12.5	17
Detect object (intrusion)	25	35
Observe	62.5	88
Face Recognition	125	175
Face Identification	250	350
Licence Plates		400
Playing cards		500
Money (notes)		800
Casino chips (39mm)		1200
(Face) Inspection	1000	1400
Money (coins)		1500

How about moving objects ?



Moving objects

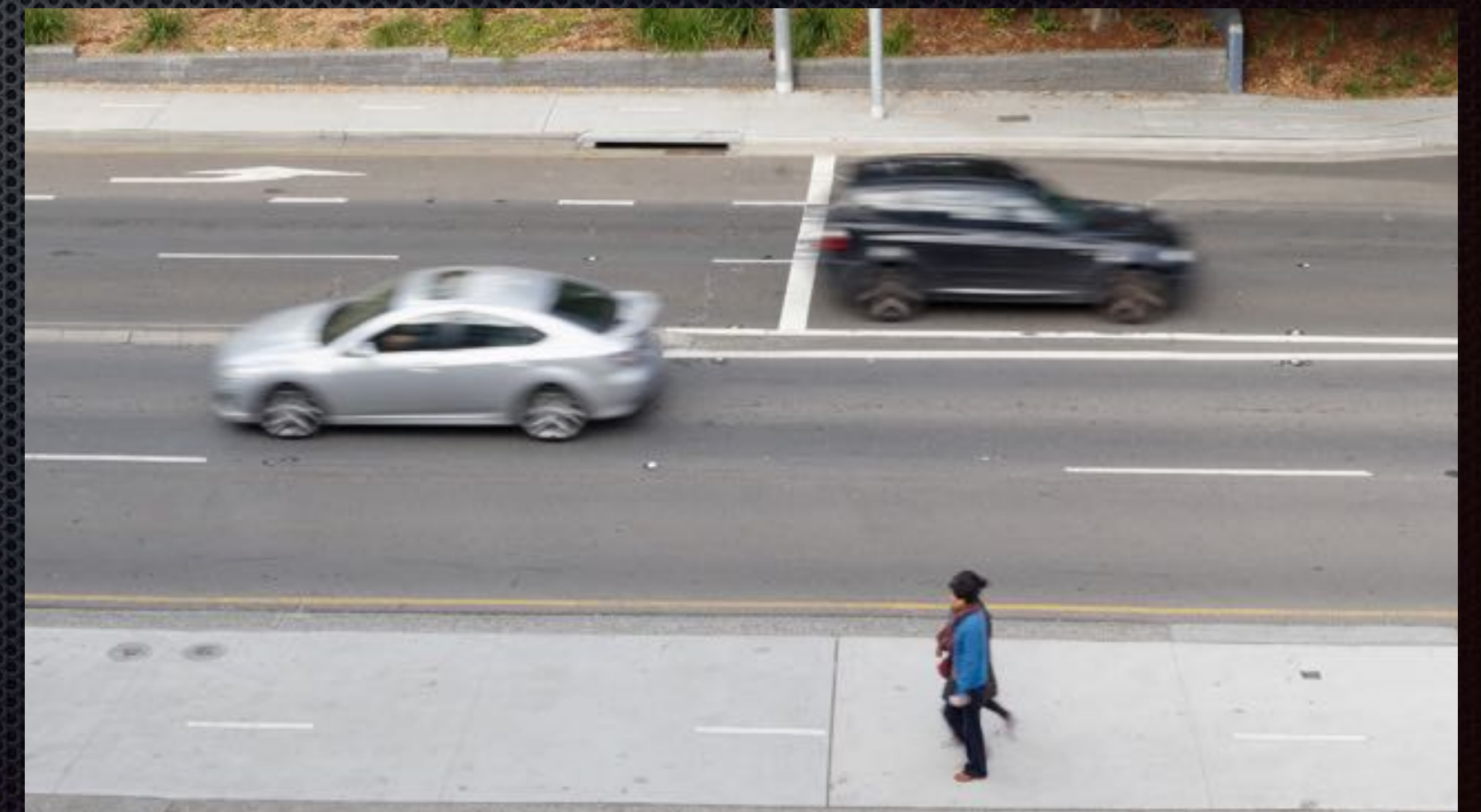
Almost all objects of interest in CCTV are moving.

Pedestrians, bicycles, vehicles, etc.

To produce 25 fps (or 30) we expose each frame approx. 40ms (33ms). This is especially true at low light, when most of the incidents in surveillance happen.

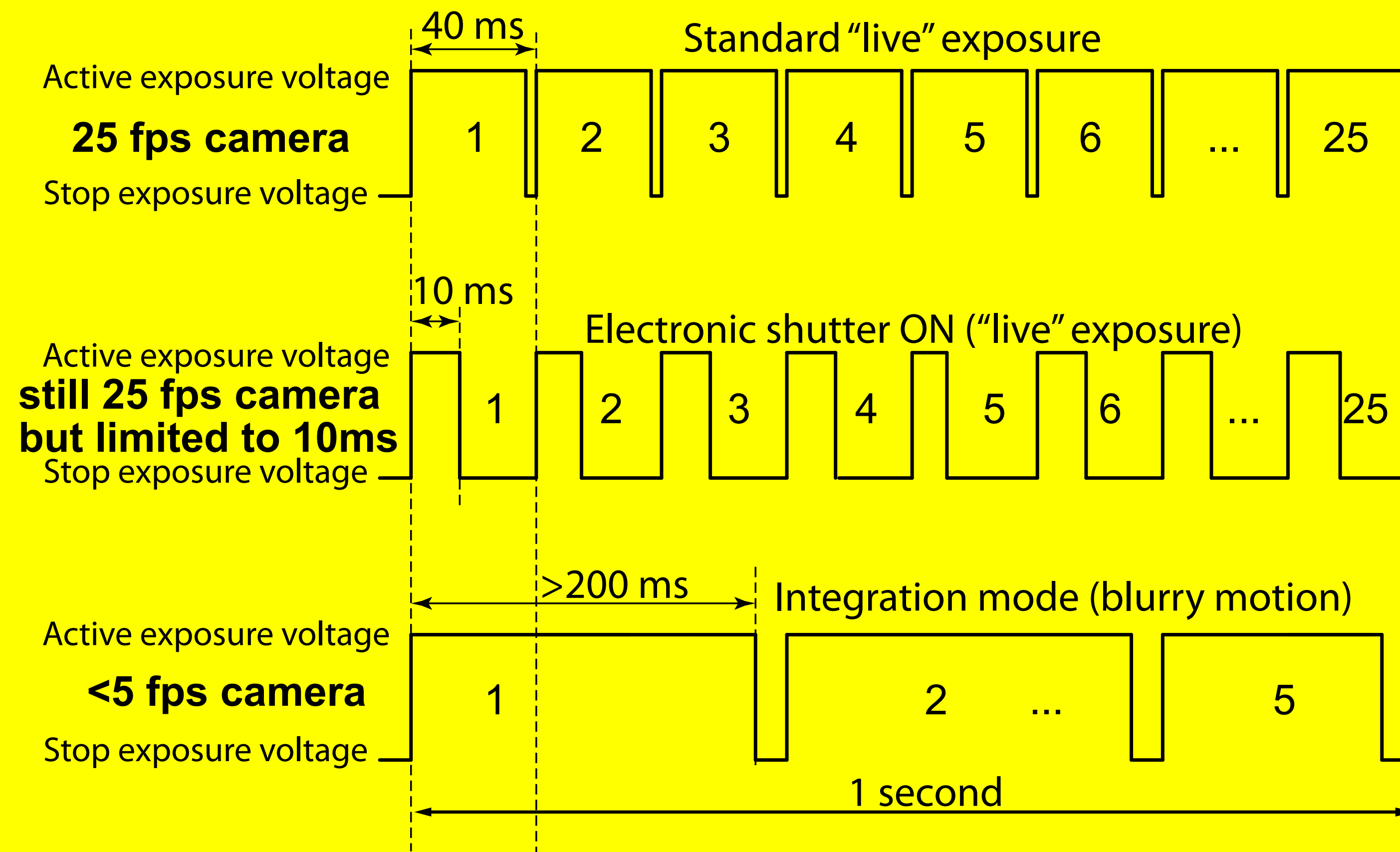
Due to their movement, at such an exposure objects appear blurry.

Blurriness depends on the **object speed, sensor size, pixel count, lens focal length, object distance and exposure.**



Electronic exposure (“shutter”)

Every CCTV camera has control over its electronic exposure.
Default value is 40ms for 25 fps or 33ms for 30 fps system.



The principles of electronic shutter

When there is sufficient light it can be shortened, automatically or manually.

The end result is **sharper images of moving objects.**



Motion blur exercise @ 1/30s (33ms)

Camera used:

Sony Alpha 7 (FX-24MP)

Lens used: 35mm (Zeiss zoom 16~35mm)

Pixel size (p_s): 0.006mm (60 microns)

Exposure used: $1/30s = 0.033s$

Distance to black car (d_c): 34m

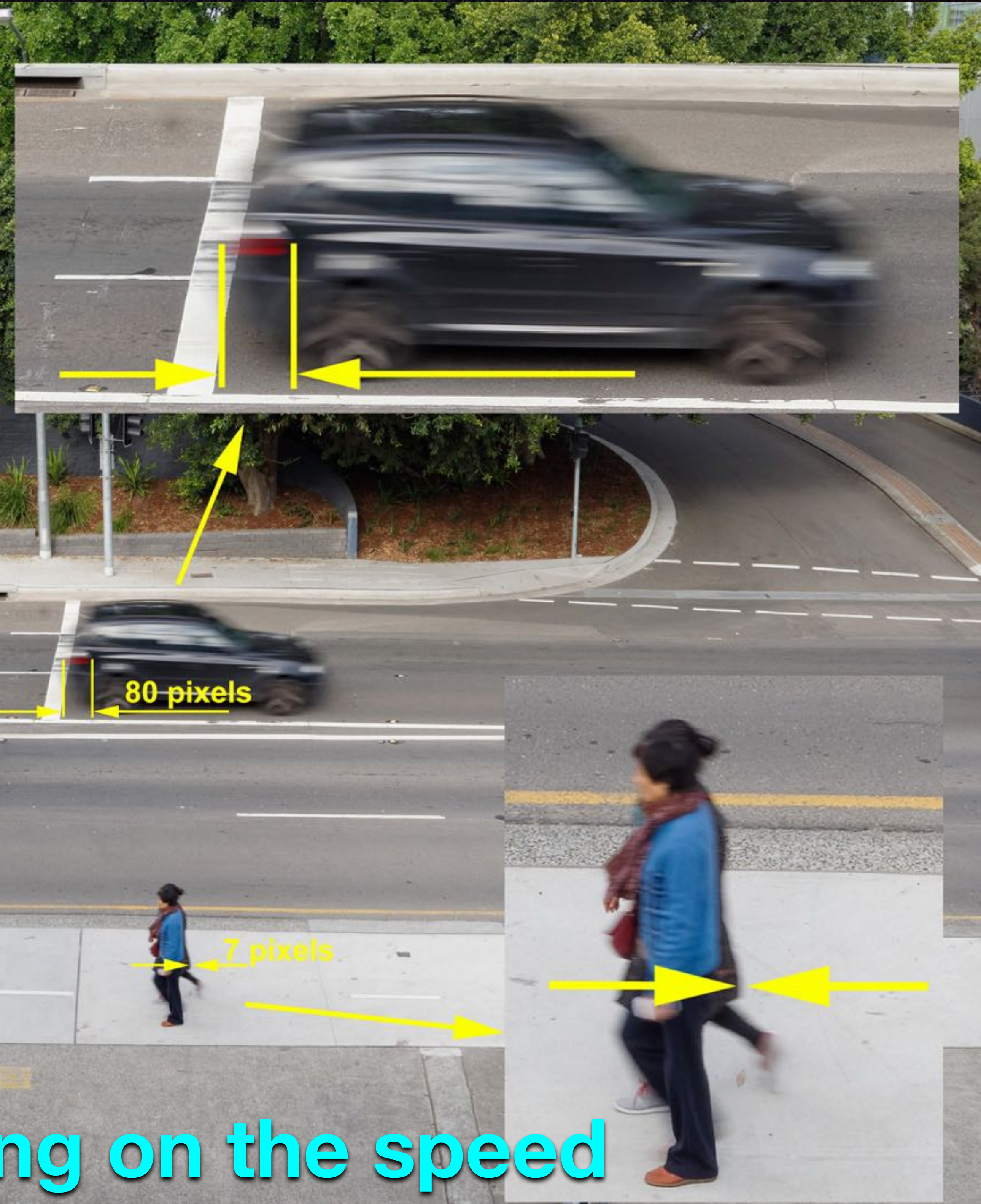
Speed of black car (v_c): 50km/h = 14m/s

Distance to walking women (d_w): 22m

Speed of walking women (v_w) = 1m/s

$p_{sc} = (35 \cdot 14 \cdot 0.033) / (34 \cdot 0.006) = 79.3 \text{ pixels}$

$p_{sw} = (35 \cdot 1 \cdot 0.033) / (22 \cdot 0.006) = 7.5 \text{ pixels}$



Various blur depending on the speed