Images as 2D signals, basic operations

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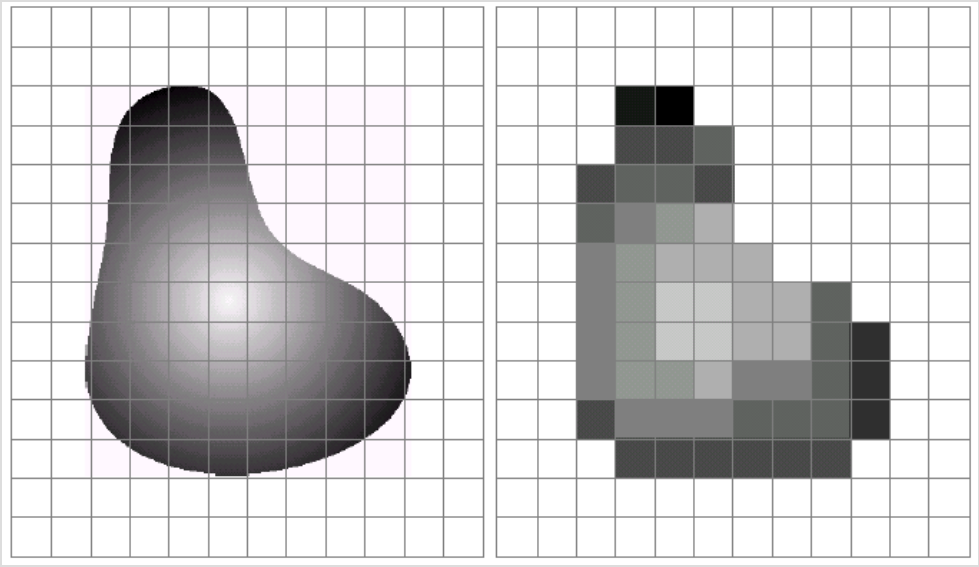
Basic properties of digital images



What characterizes a digital image?

- *Geometric resolution* (number of pixels)
- *Photometric resolution* (number of bits per pixel)
- *Spectral resolution* (number of color channels)

Image Sensor(s)

Image sensors convert light energy to electrical signals

Today there are two main technologies: CCD and CMOS sensors

CCD (Charged Coupling Devices) Collect light and convert it to electrons in the sensor
CMOS (complementary metal-oxide semiconductor) uses additional circuitry on the chip

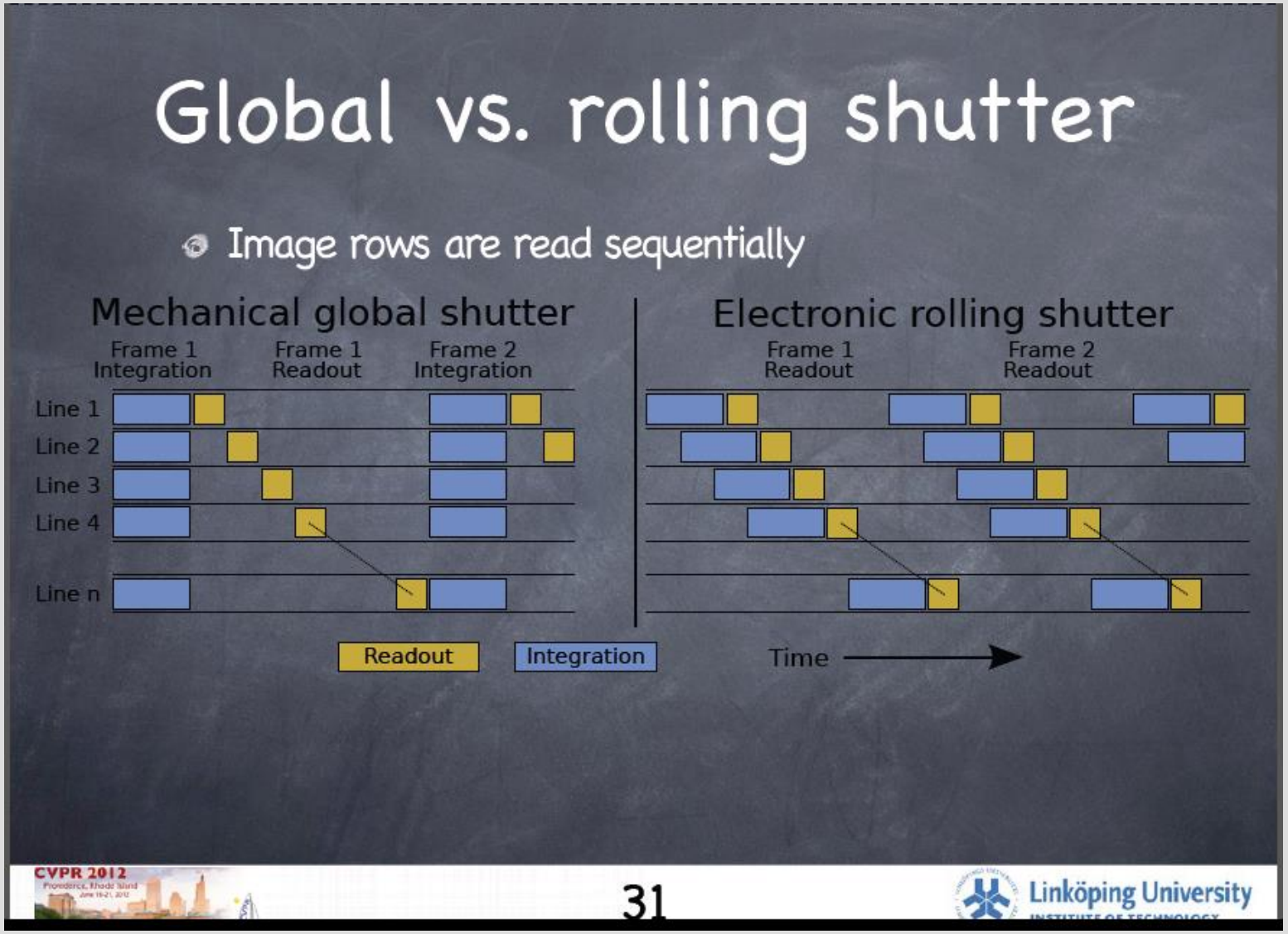
Some differences:

- CCD uses global shutter, CMOS rolling shutter
- CCD is more expansive
- Most still cameras use nowadays CMOS
- Power consumption
- Processing on the sensor

References:

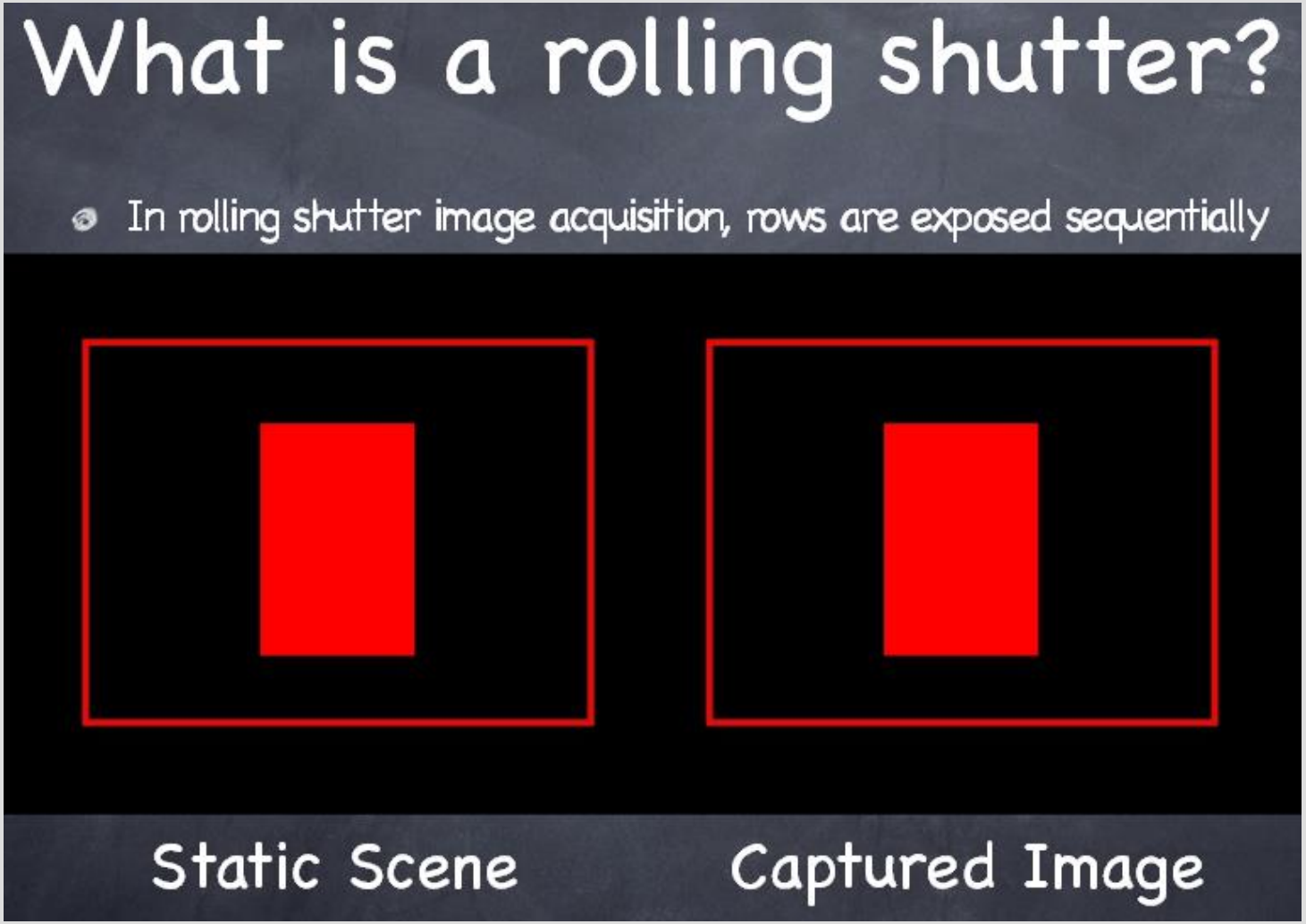
https://en.wikipedia.org/wiki/Image_sensor
http://www.axis.com/files/whitepaper/wp_ccd_cmos_40722_en_1010_lo.pdf

Global – Rolling Shutter

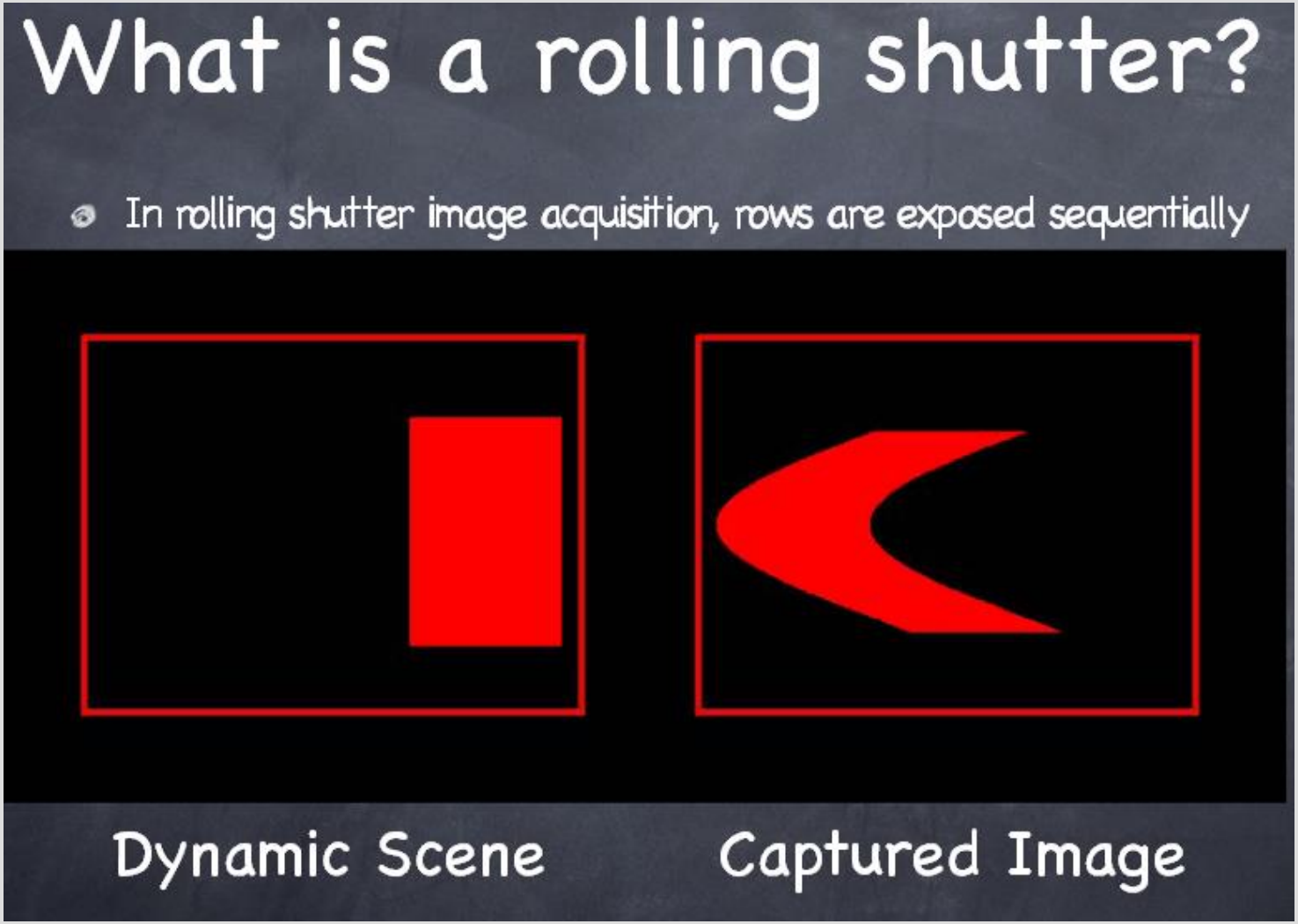


Rolling Shutter Tutorial

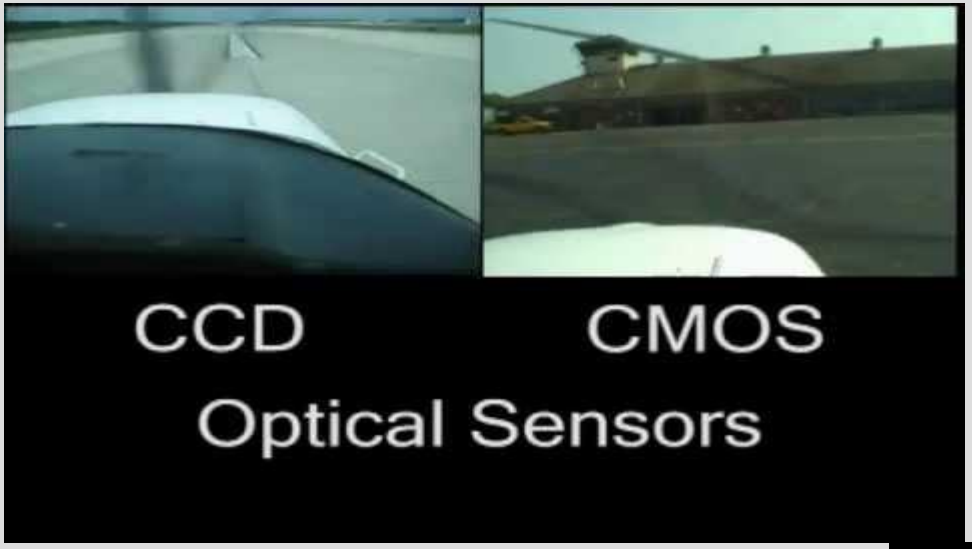
Global Shutter



Rolling Shutter

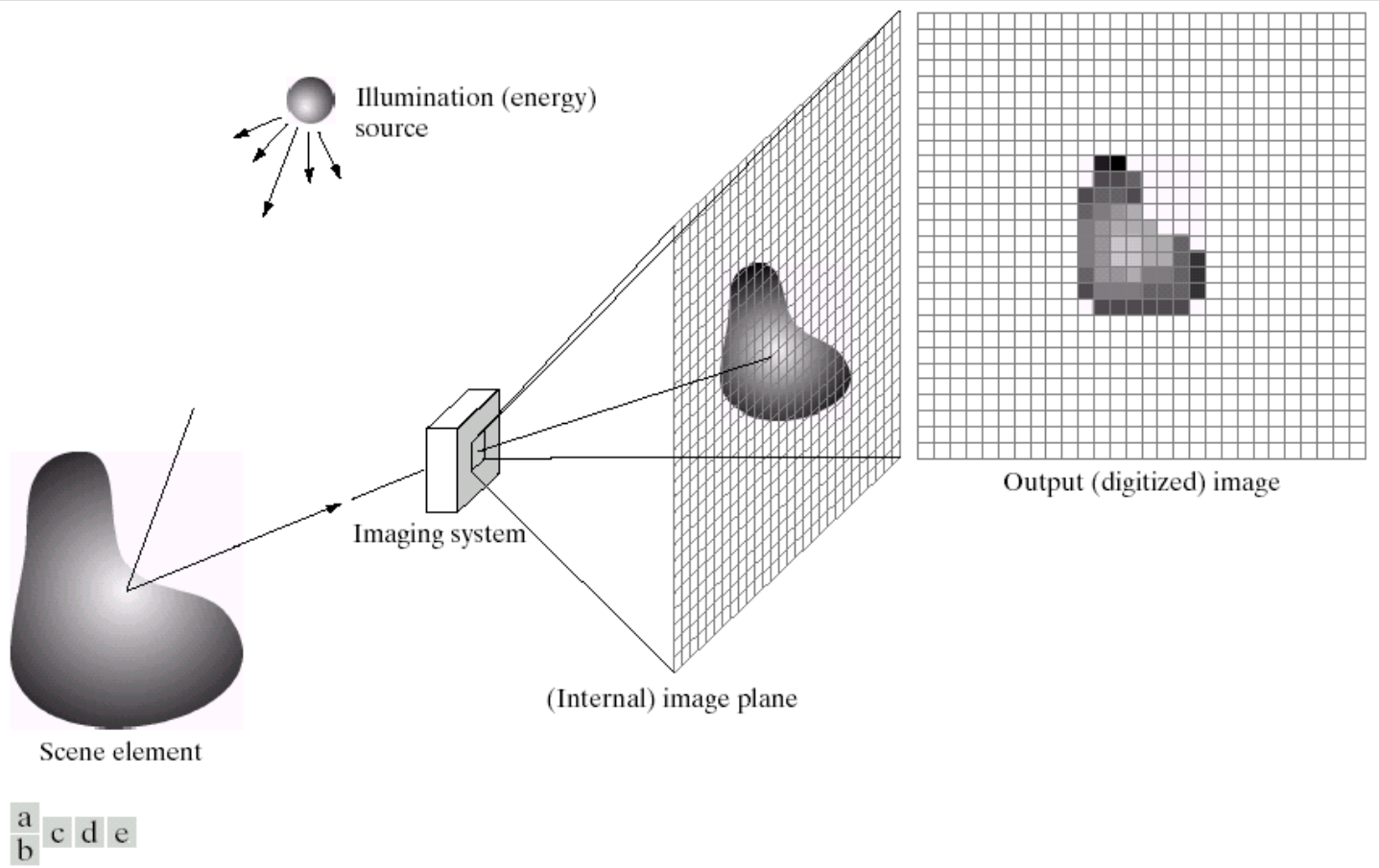


Rolling Shutter Example



propeller explained

Image formation



a
b c d e

FIGURE 2.15 An example of the digital image acquisition process. (a) Energy ("illumination") source. (b) An element of a scene. (c) Imaging system. (d) Projection of the scene onto the image plane. (e) Digitized image.

$$f(x,y) = i(x,y)r(x,y)$$

$$0 \leq i(x,y) < \infty$$

$$0 \leq r(x,y) \leq 1$$

Sampling and quantization

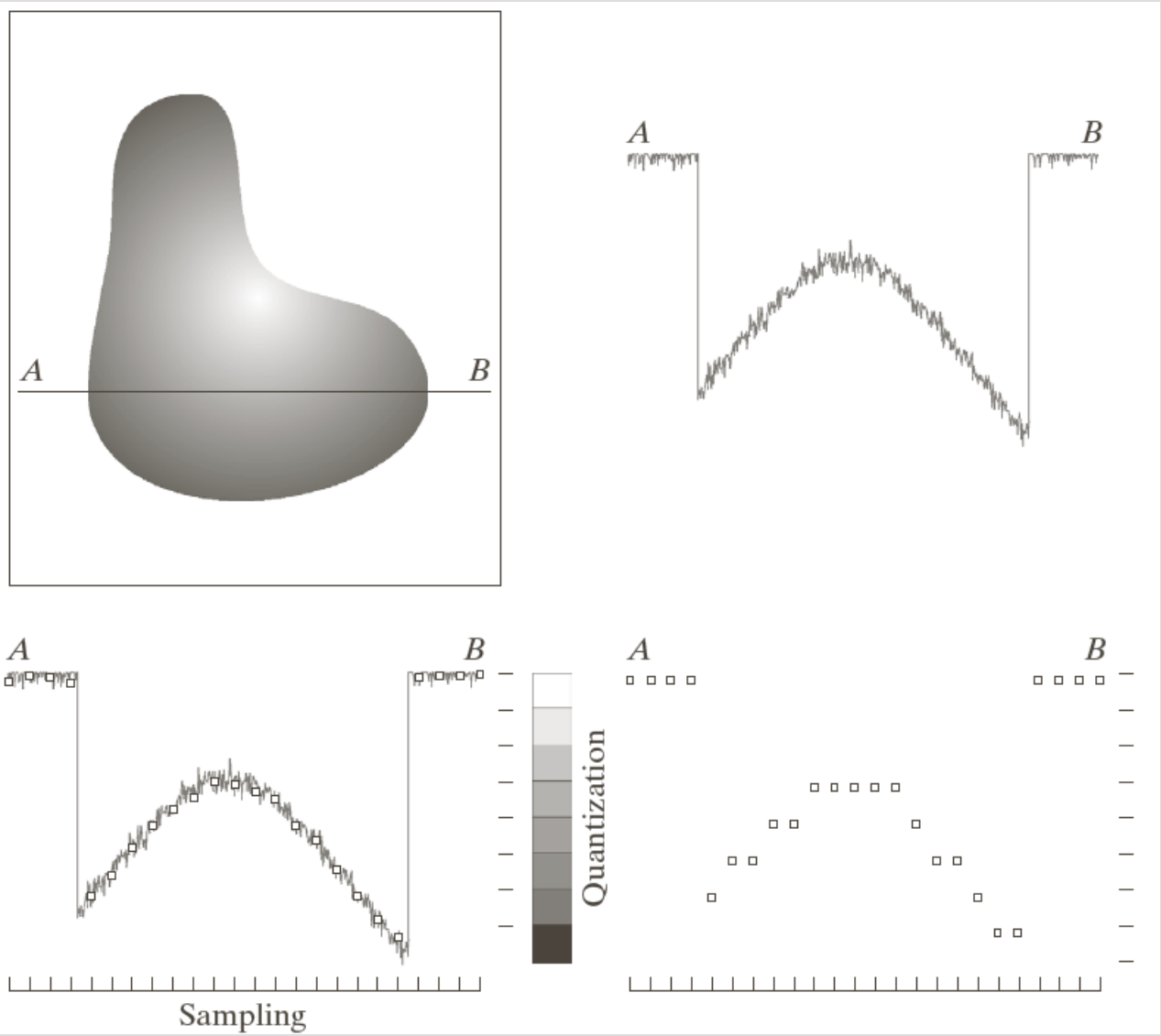
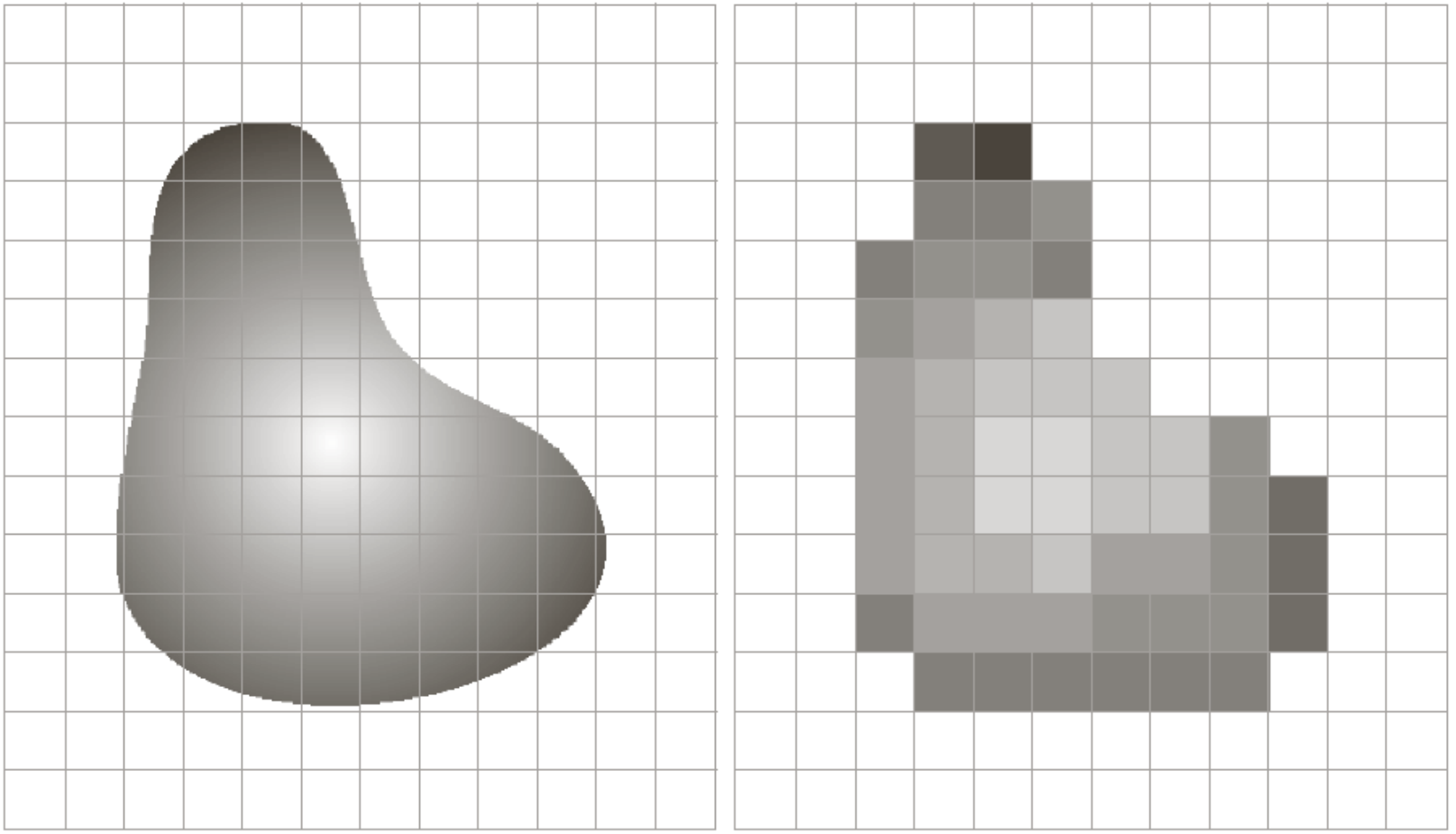


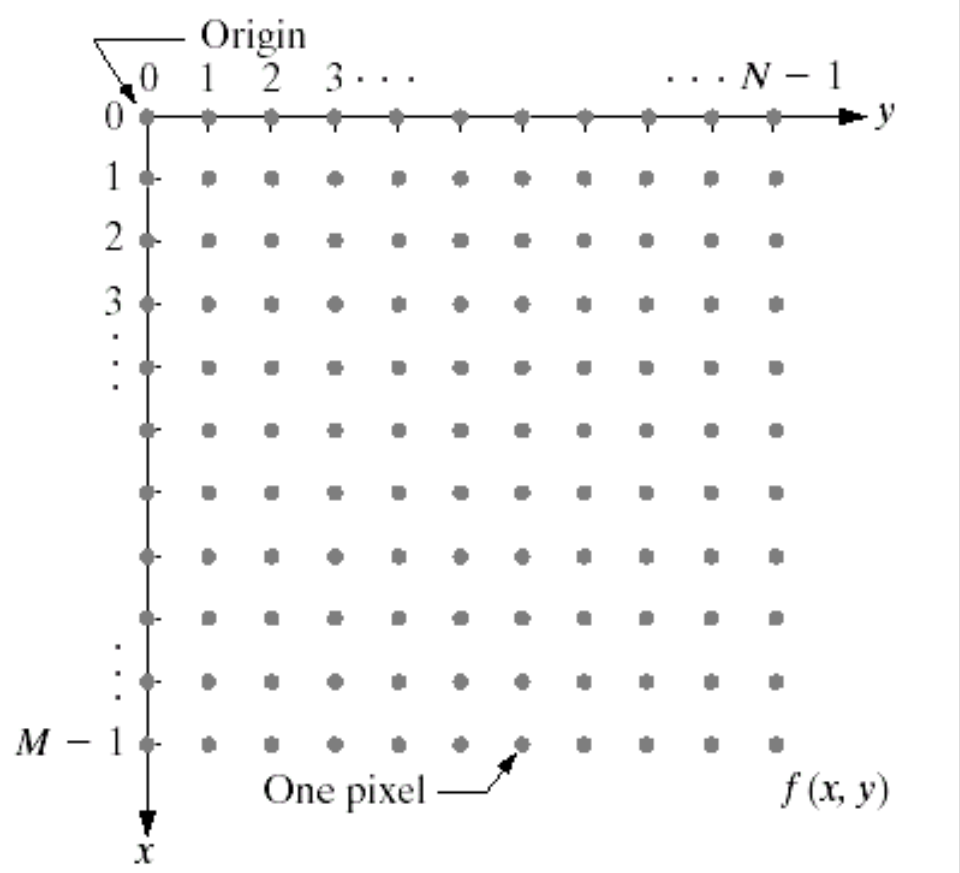
Fig 2.16



a b

FIGURE 2.17 (a) Continuous image projected onto a sensor array. (b) Result of image sampling and quantization.

Coordinate system



Basic Matlab Programming

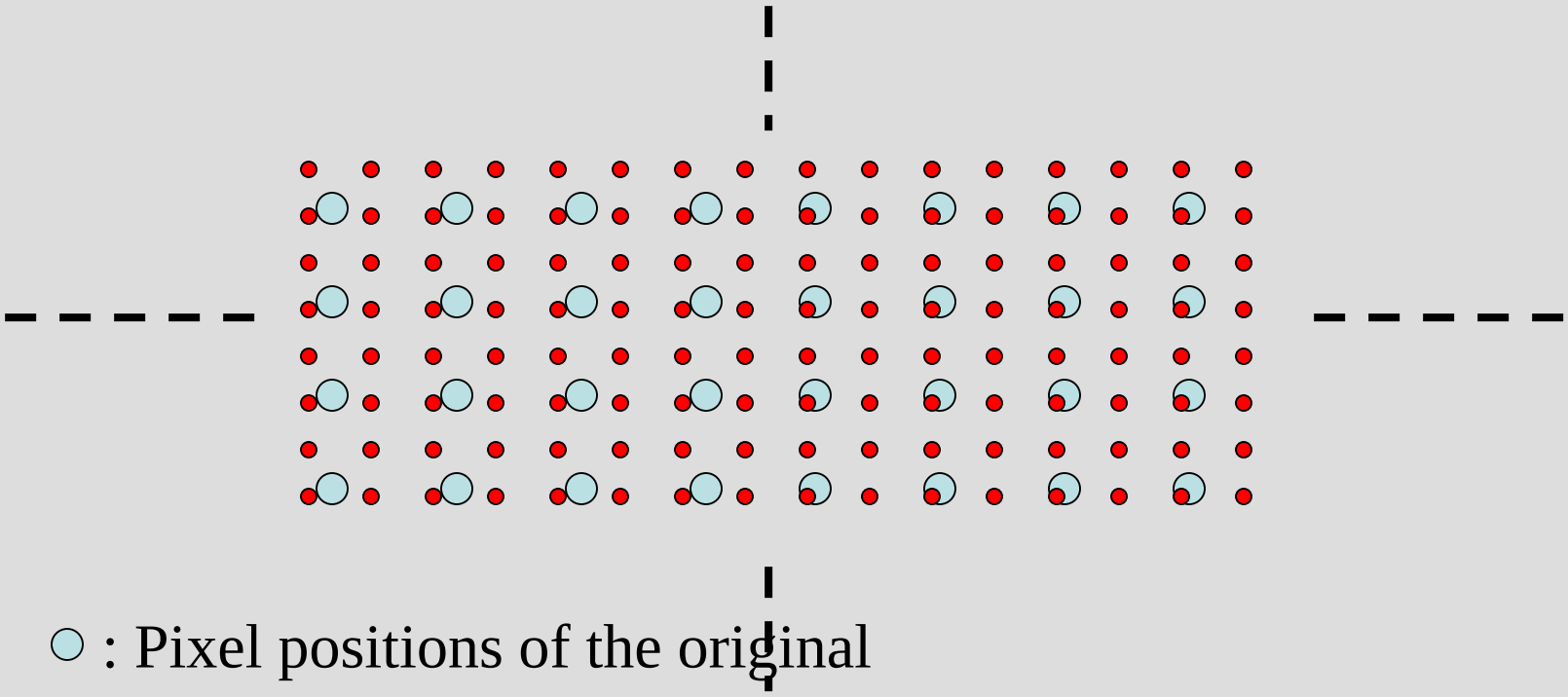
Some commands/constructions/examples are in

..\Matlab\MatlabIntro.m

Matlab has a publish functionality which runs the script and produces html code with the results

..\Matlab\html\MatlabIntro.html

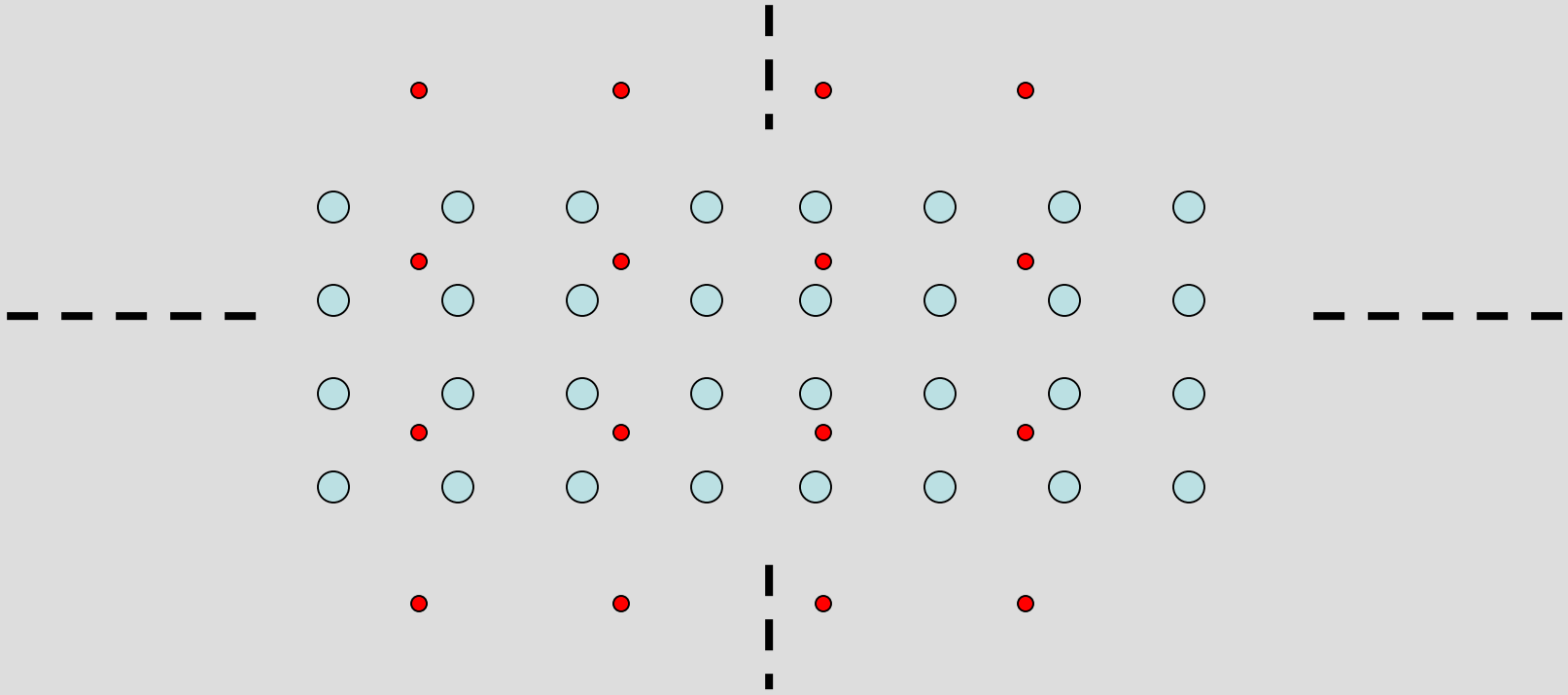
Zooming (upsampling)



○ : Pixel positions of the original

• : Pixel positions of the resampled (zoomed) image

Shrinking (downsampling)



○ : Pixel positions of the original

• : Pixel positions of the resampled (shrunk) image