Digital Image Processing Using MATLAB

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Light & Electromagnetic Spectrum

$$\lambda = c / v$$

Where,

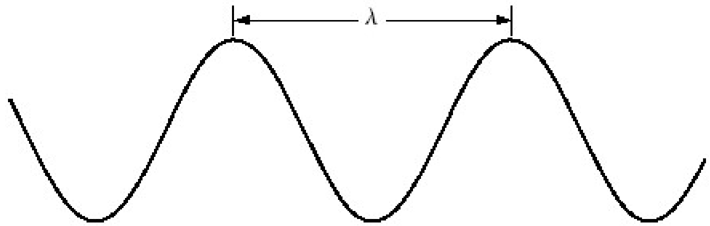
λ is Wavelength in micro-meter or nano-meter range

C = 2.998 m/sec

v = Frequency in Hertz

Light & Electromagnetic Spectrum

FIGURE 2.11
Graphical representation of one wavelength.



Light & Electromagnetic Spectrum

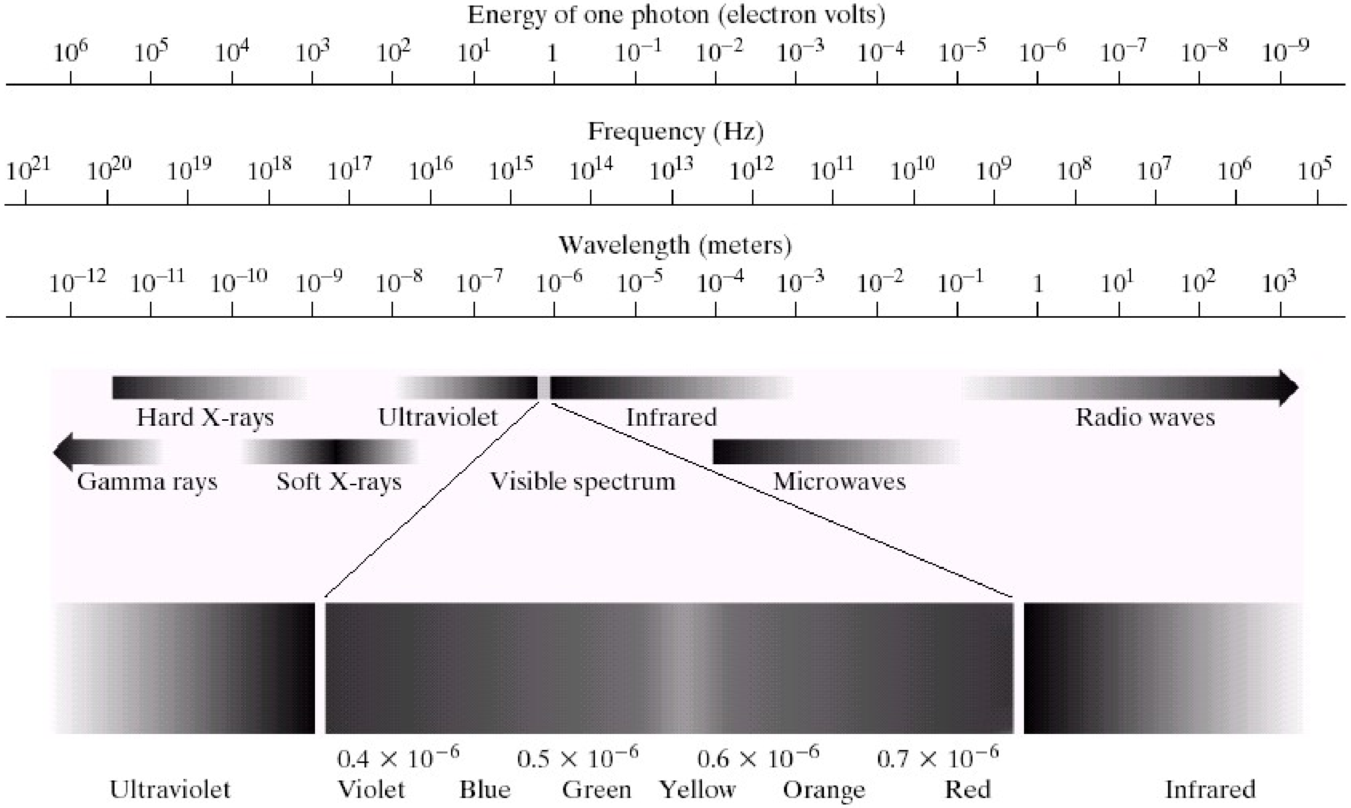


FIGURE 2.10 The electromagnetic spectrum. The visible spectrum is shown zoomed to facilitate explanation, but note that the visible spectrum is a rather narrow portion of the EM spectrum.

Light & Electromagnetic Spectrum

$$E = h\,v$$

Where,

E is Energy in Electron volt

h = Planck's Constant

v = Frequency in Hertz

Light & Electromagnetic Spectrum

Colors that human perceive in an object are determined by the nature of the light reflected from that object

Light that is void of color is called monochromatic light i.e. gray-level or intensity.

Color (chromatic) light spans the electromagnetic energy spectrum from approximately 0.43 micro-meter to 0.79 micro-meter.

Radiance, Luminance and **Brightness are used to describe the quality of a color light source.**

Light & Electromagnetic Spectrum

Radiance is the total amount of energy that flows from the light source. It is measured in Watts

Luminance measured in lumens gives a measure of amount of energy an observer perceives from a light source.

Brightness is a subjective descriptor of light perception.

Light & Electromagnetic Spectrum

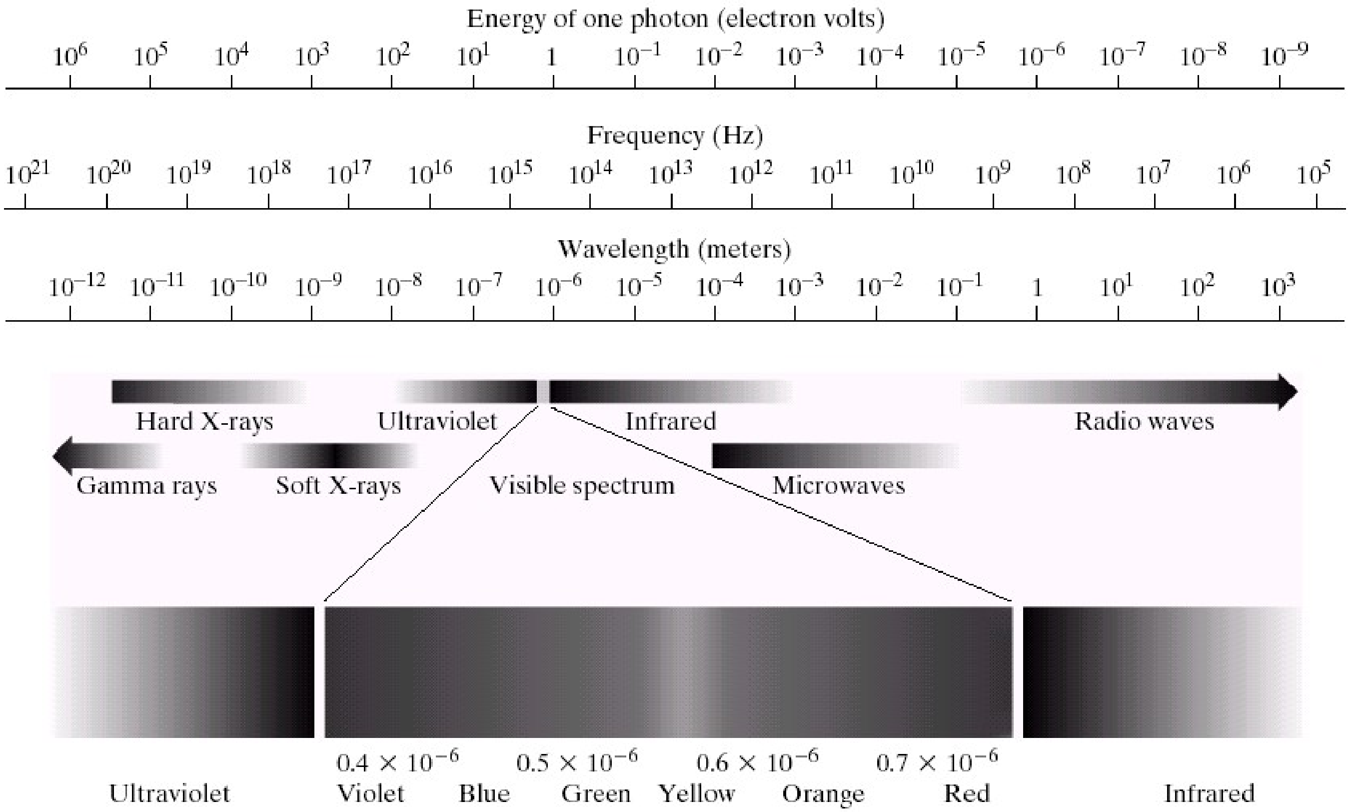


FIGURE 2.10 The electromagnetic spectrum. The visible spectrum is shown zoomed to facilitate explanation, but note that the visible spectrum is a rather narrow portion of the EM spectrum.

Light & Electromagnetic Spectrum

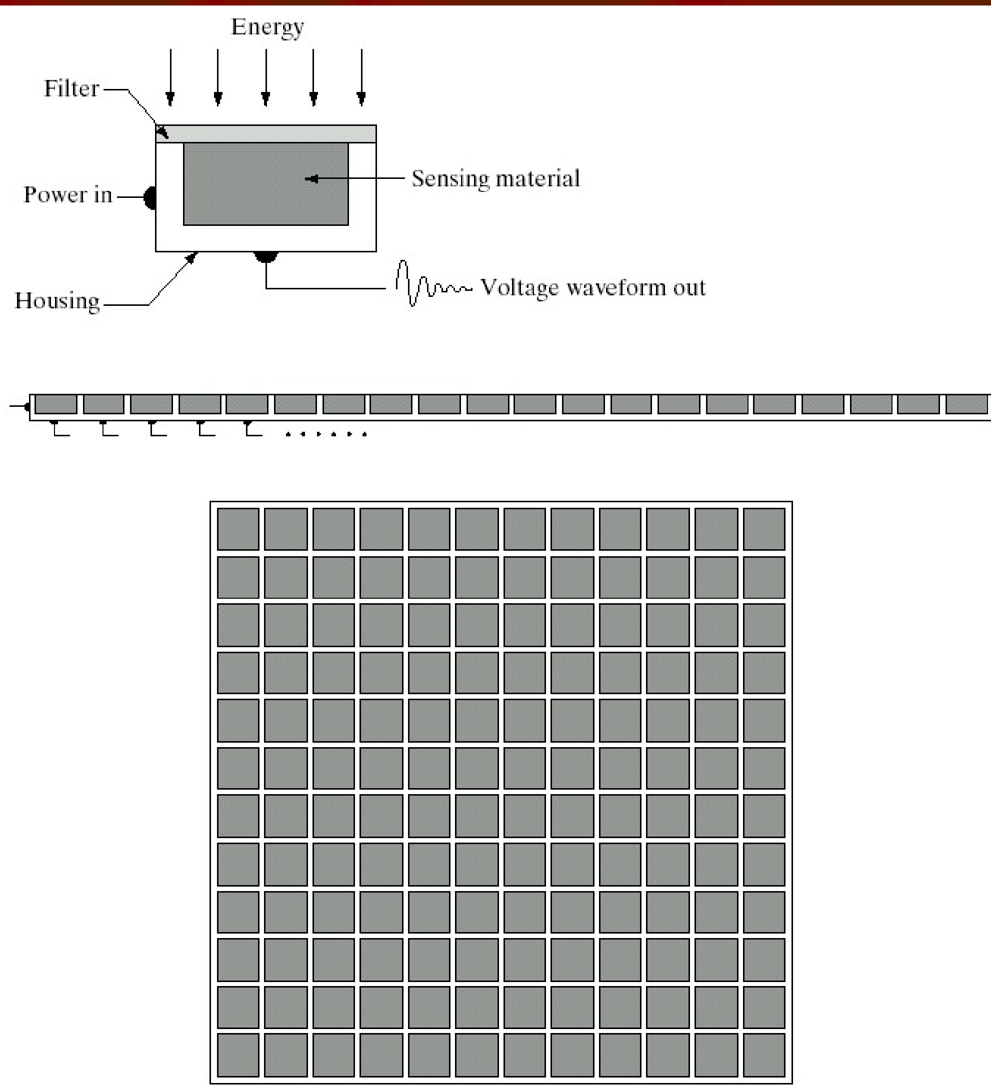


FIGURE 2.12
(a) Single imaging sensor.
(b) Line sensor.
(c) Array sensor.

Light & Electromagnetic Spectrum

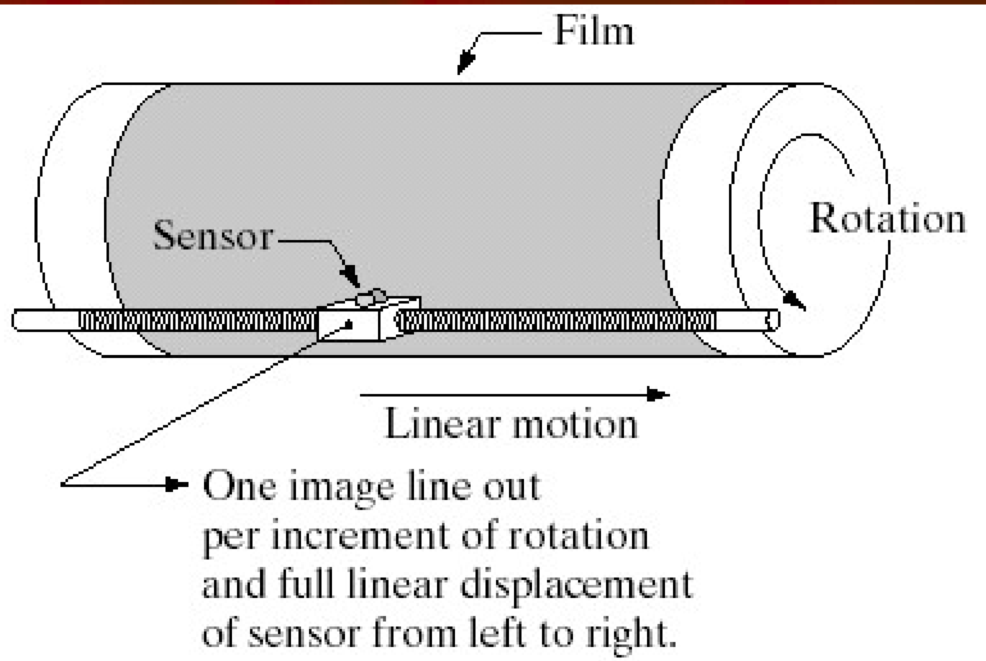


FIGURE 2.13 Combining a single sensor with motion to generate a 2-D image.

Light & Electromagnetic Spectrum

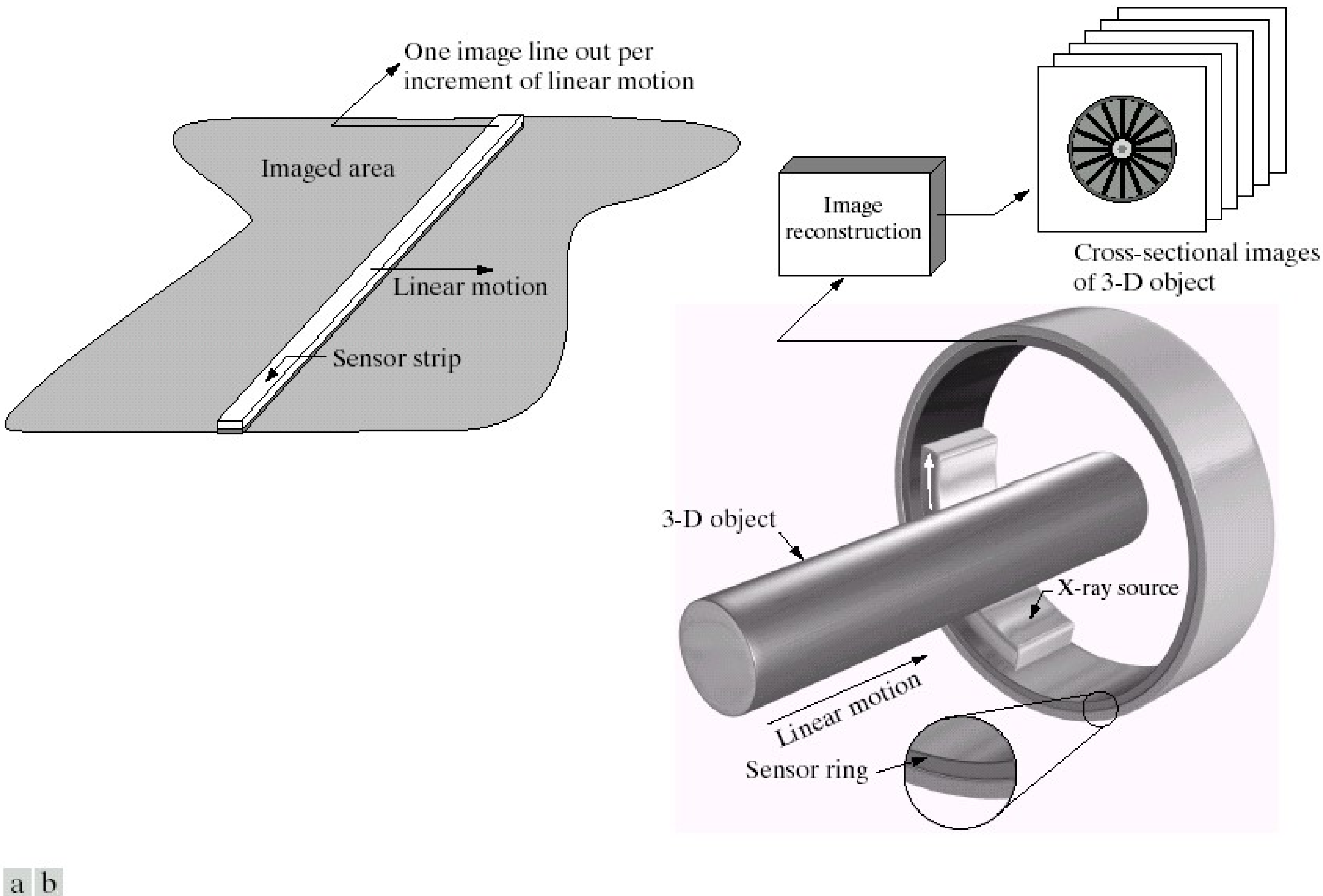


FIGURE 2.14 (a) Image acquisition using a linear sensor strip. (b) Image acquisition using a circular sensor strip.

Image Acquisition Process

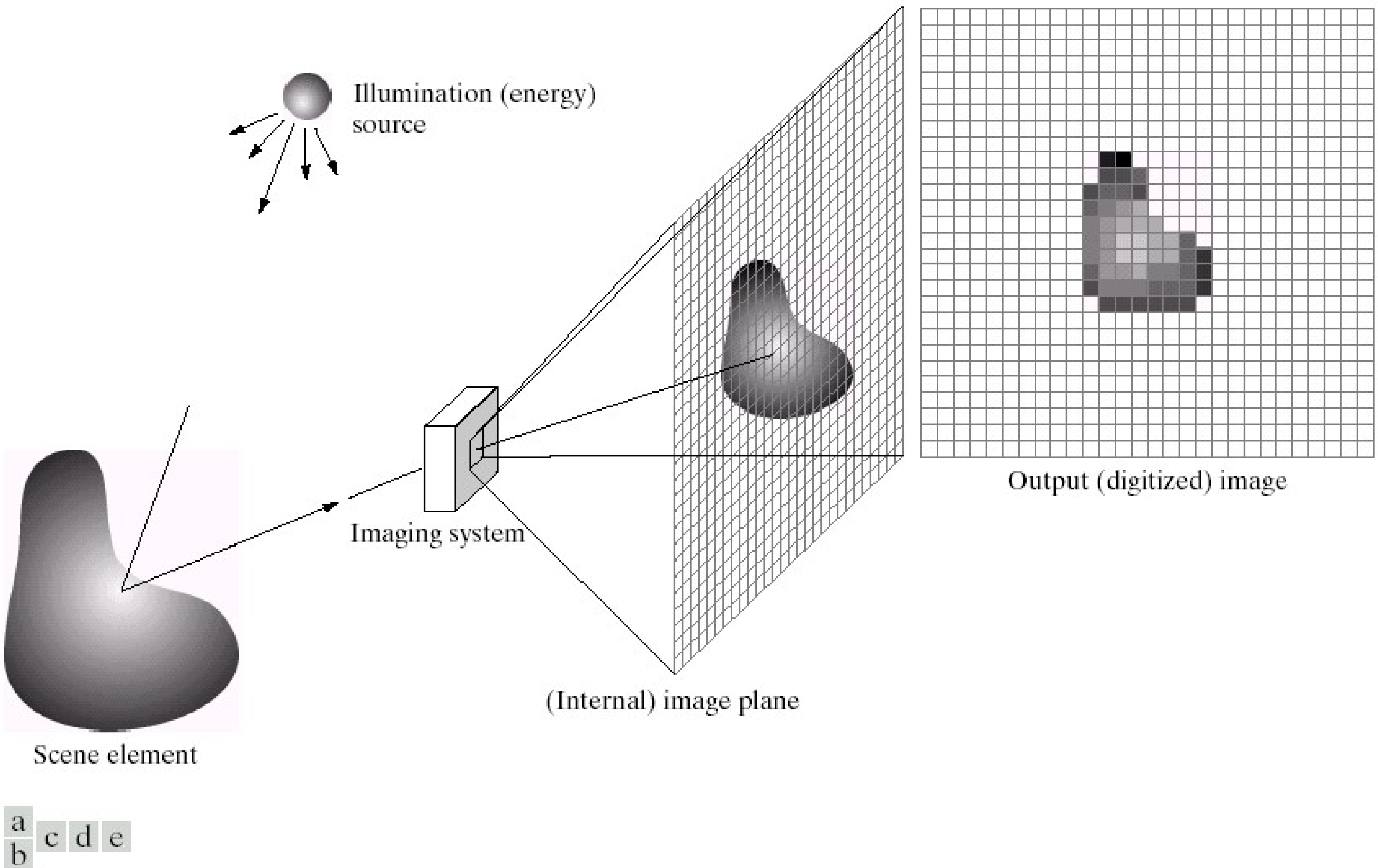


FIGURE 2.15 An example of the digital image acquisition process. (a) Energy ("illumination") source. (b) An element of a scene. (c) Imaging system. (d) Projection of the scene onto the image plane. (e) Digitized image.

Image Formation Model

Monochrome image $f(x,y)$ may be characterized by two components :

Illumination: $i(x,y)$ **Reflectance:** $r(x,y)$

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

$0 < i(x,y) < \infty$ $0 < f(x,y) < \infty$ $0 < r(x,y) < 1$

Typical values of the illumination and reflectance:

Illumination: sun on earth: 90,000 lm/m^2 on a sunny day; 10,000 lm/m^2 on a cloud day; moon on clear evening: 0.1 lm/m^2; in a commercial office is about 1000 lm/m^2

Reflectance: 0.01 for black velvet, 0.65 for stainless steel, 0.80 for flat-white wall paint, 0.90 for silver-plated metal, and 0.93 for snow

Image Sampling and Quantization

- The output of most sensors is a continuous voltage waveform whose amplitude and spatial behavior are related to the physical phenomenon being sensed.

- To create a digital image, we need to convert the continuous sensed data into digital form. This involves two processes: *sampling* and *quantization*.

Sampling and Quantization

- To convert it to digital form, we have to sample the function in both coordinates and in amplitude.
- Digitizing the coordinate values is called *sampling*.
- Digitizing the amplitude values is called *quantization*.

Sampling and Quantization

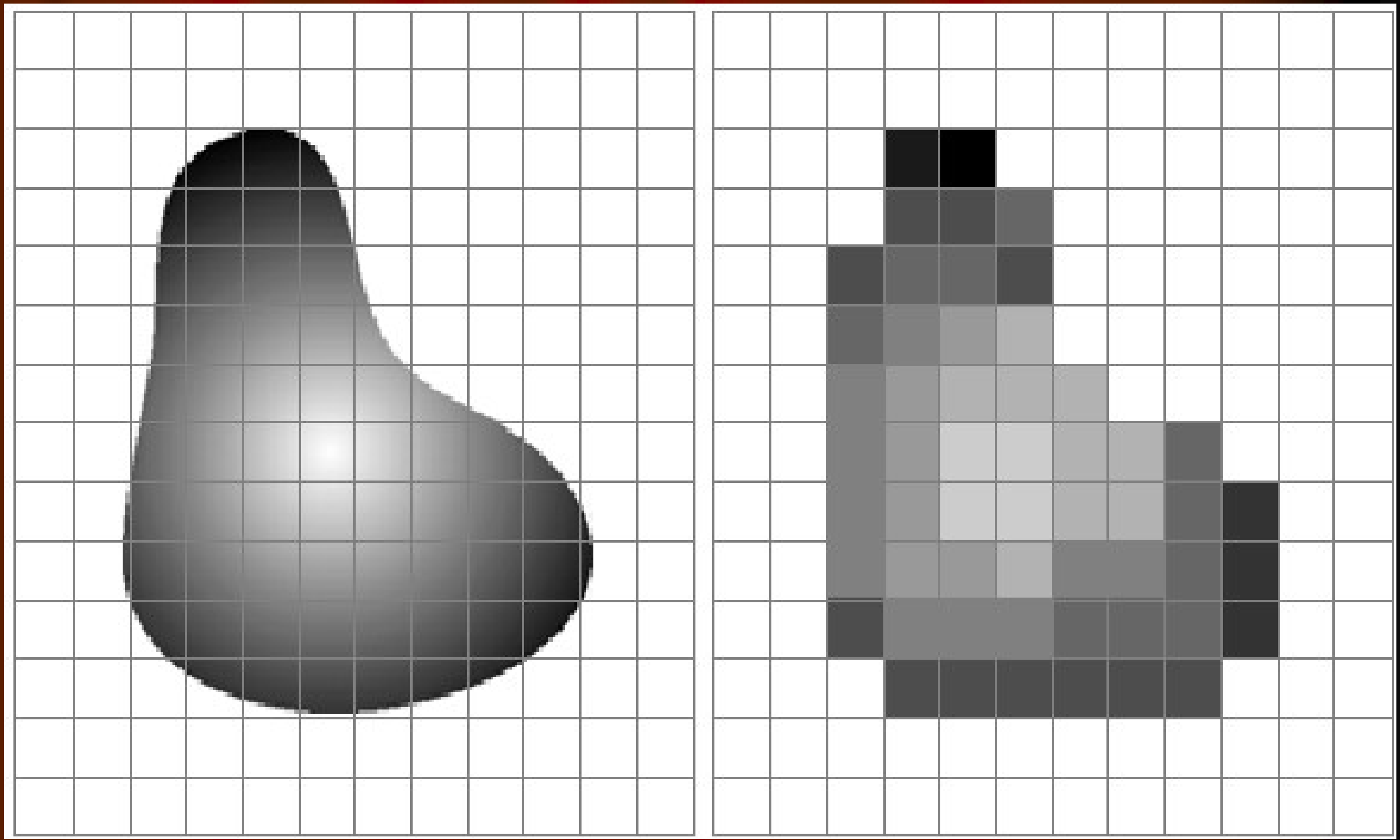
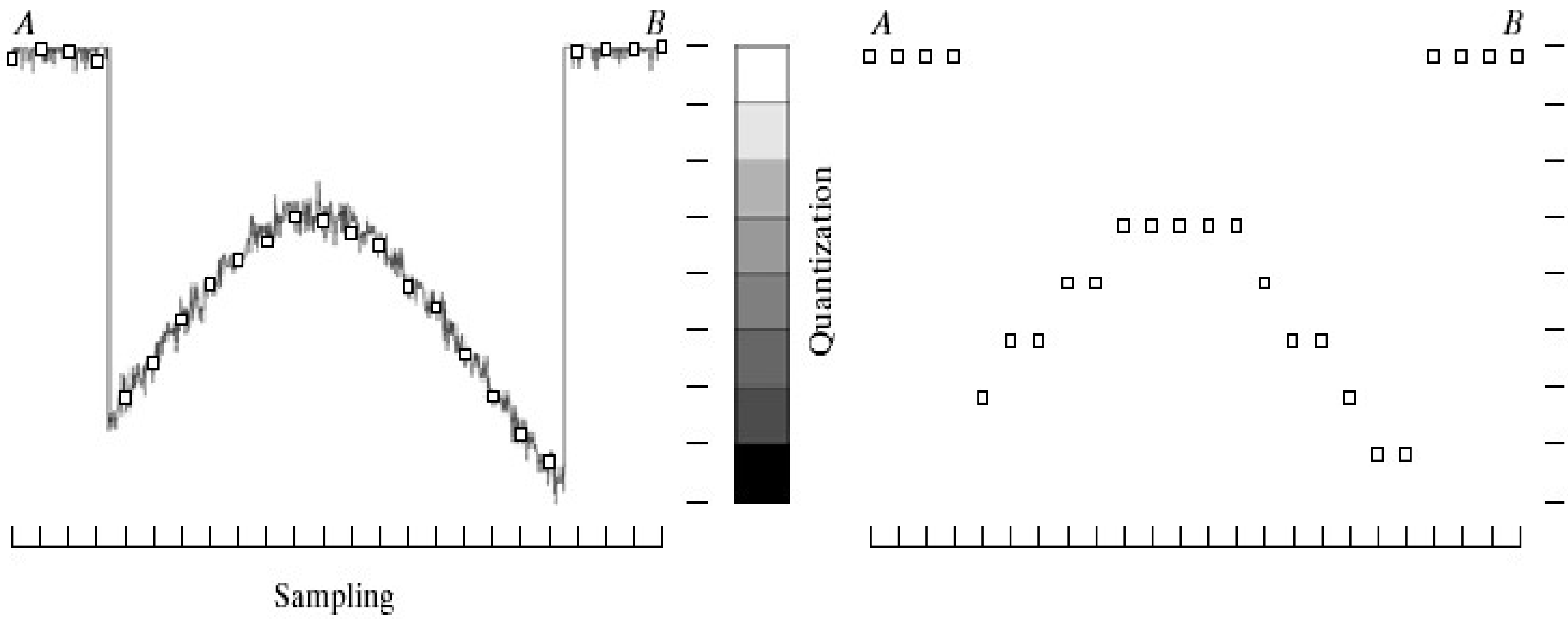
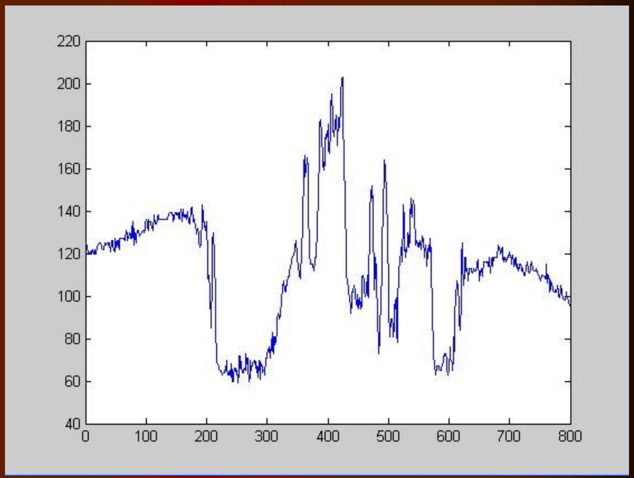


Image before sampling and quantization   Result of sampling and quantization

Sampling and Quantization



Extract Scan line of a Gray Scale Image



A = imread(‘E:\Sunset_GrayScale’, ’jpg’);

Imshow (A);

[m , n] =size (A);

X= linspace(1,n,n);

Y= A(m/2, :);

Figure, plot(X, Y)

Extract Red, Green & Blue plane of a Color Image

A = imread(‘E:\Sunset’, ’jpg’);

Imshow (A);

[m , n, p] =size (A);

R=A(:, :, 1);

Figure, imshow (R);

G=A(:, :, 2);

Figure, imshow(G);

B=A(:, :, 3);

Figure, imshow(B);