

Digital Image Processing

Fundamental Steps

Fundamental steps in DIP

Image Acquisition

Image Filtering &
Enhancement

Image Restoration
(dealing with any
degradation)

Color Image
Processing

Wavelets &
Multiresolution
Processing

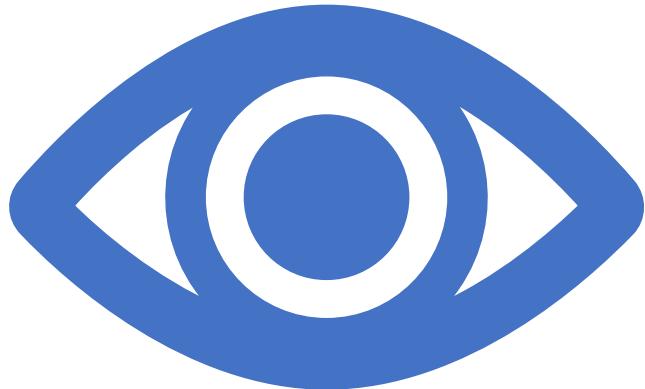
Compression

Morphological
Processing

Segmentation

Representation &
Description

Object
Recognition

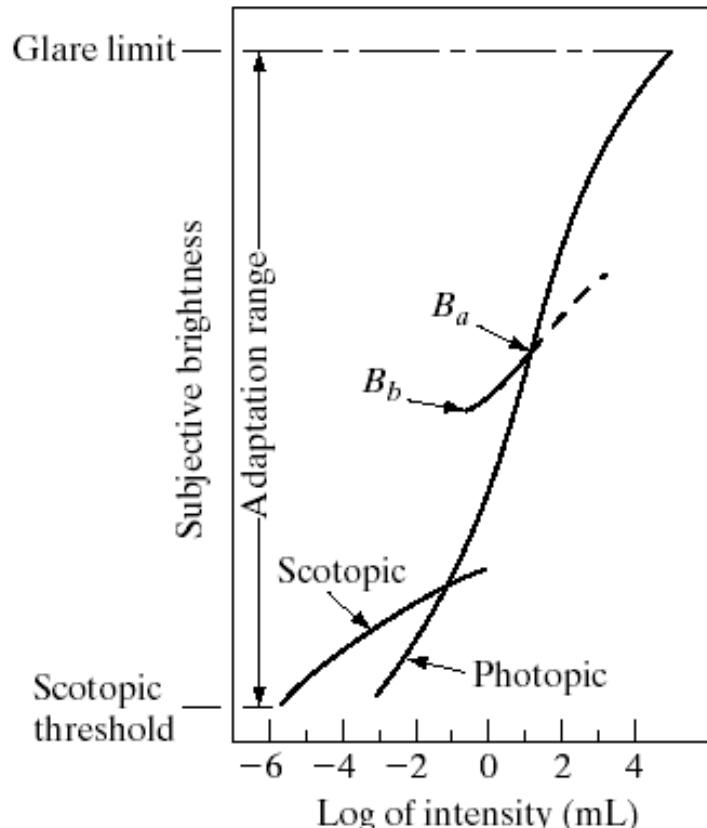


Visual perception

Size of image on retina =
 $17\text{mm} * \text{size of object}/\text{distance from eye}$

Brightness adaptation and discrimination

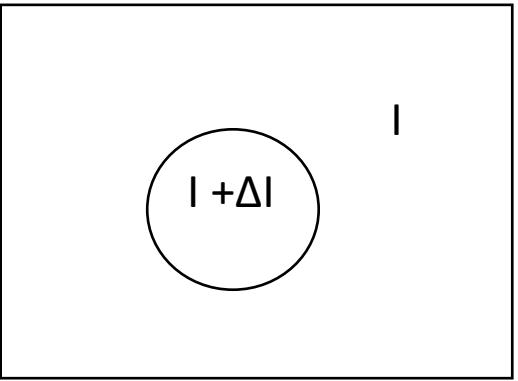
- Human eye adapted to intensity levels from Scotopic threshold to glare limit



Subjective brightness : intensity perceived by human visual system.

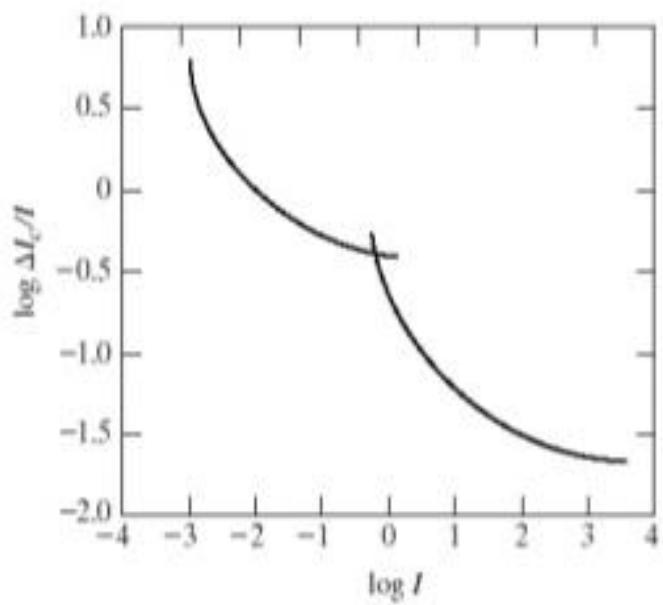
Brightness adaptation : changing of overall sensitivity of visual system to operate from scotopic threshold to glare limit.

Brightness adaptation level : Current sensitivity level of the visual system.

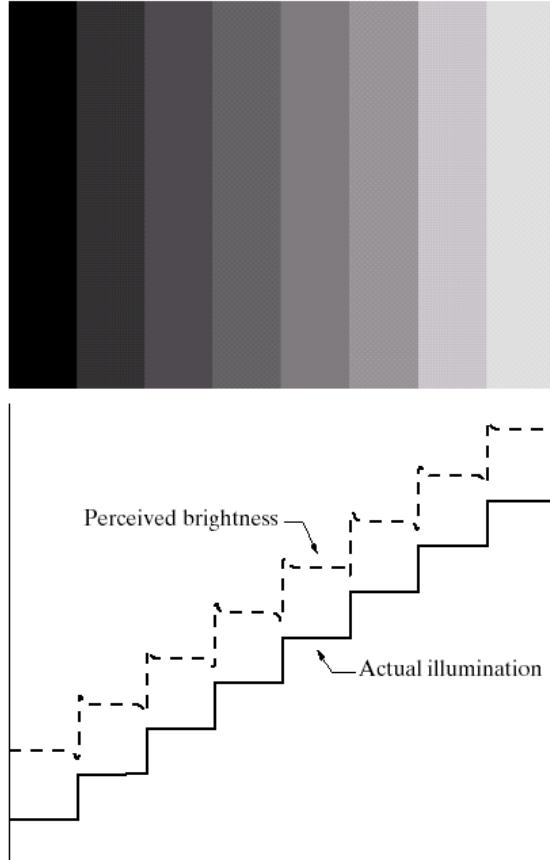


Weber ratio : $(\Delta I_c / I)$

If weber ratio is small, there is good brightness discrimination



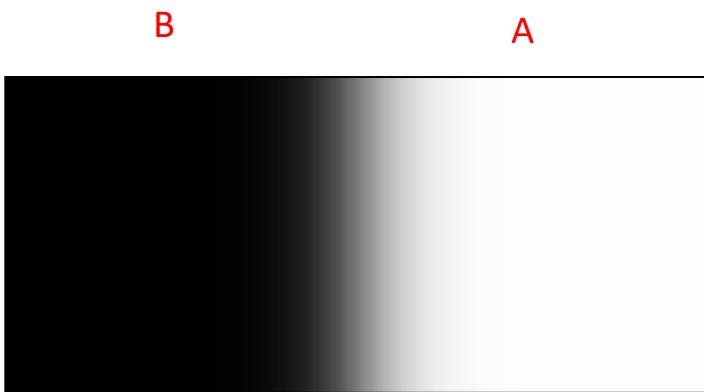
Brightness discrimination is poor at low levels of illumination.



Mach band effect:

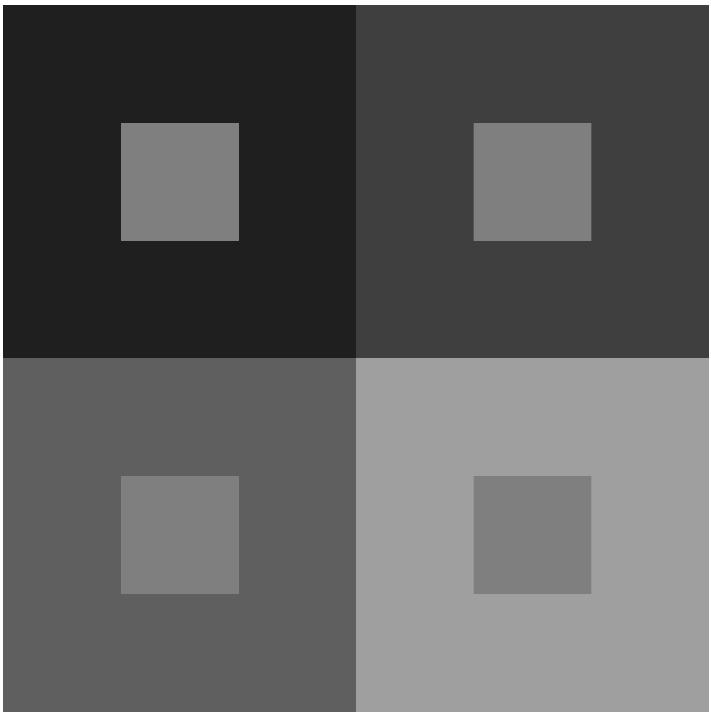
Visual system tend to undershoot or overshoot around the boundary regions of different intensities.

In this image, edges between bars appear brighter on the right side and darker on the left side.



In area A,
brightness
perceived is darker
while in area B is
brighter. This
phenomenon is
called Mach band
effect

Simultaneous contrast



- Region's perceived brightness does not depend simply on its intensity
- Intensities of surrounding points effect perceived brightness at each point.

All small squares have exactly the same intensity but they appear progressively darker as background becomes lighter.

Simultaneous contrast refers to the manner in which the colors of two different objects affect each other. The effect is more noticeable when shared between objects of complementary color.

Light and EM spectrum

- Higher frequency EM phenomenon carries more energy per photon.
- Radio waves have photons with least energy and Gamma rays with most energy.

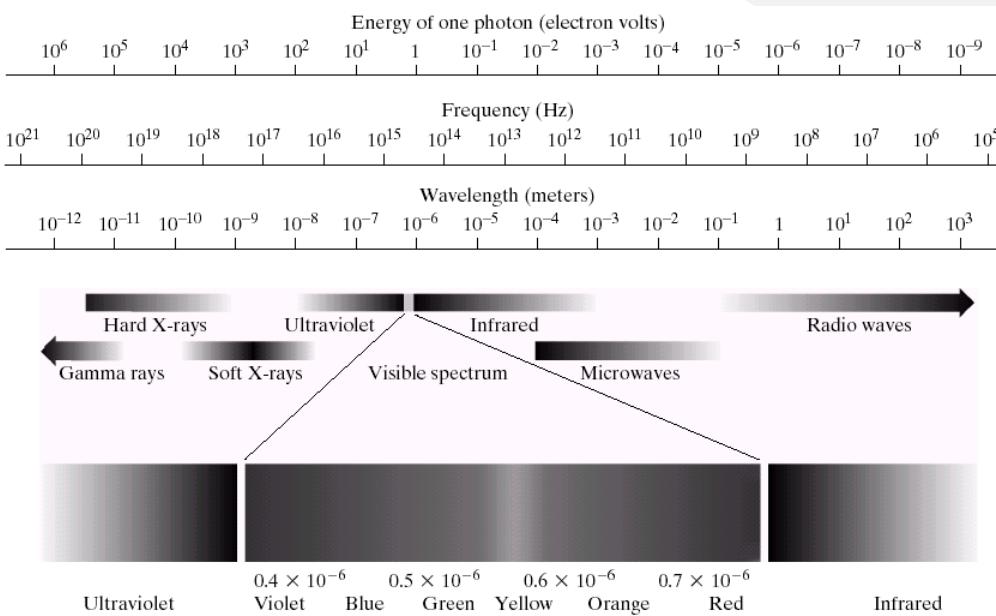


FIGURE 2.10 The electromagnetic spectrum. The visible spectrum is shown zoomed to facilitate explanation, but note that the visible spectrum is a rather narrow portion of the EM spectrum.

Monochromatic light

- Also called achromatic light, void of any color.
- The only attribute is its intensity or amount
- Gray level to denote intensity
- Gray scale
- Gray scale images

Chromatic light

- 0.43 – 0.79 um
- Radiance – total amount of energy that flows from light source. (Watts)
- Luminance – measure of amount of energy an observer perceives from the light source. (Lumens)
- Brightness – subjective descriptor of light perception that is practically impossible to measure.

Food for thought!

1. Why does the same object look different in brightness when we see it in a dark room versus bright sunlight?
2. If two image regions have slightly different brightness, why can we sometimes notice the difference and sometimes not?
3. Why do edges in an image often appear sharper or more prominent to our eyes than flat regions?
4. How can two areas with the same actual intensity appear different because of their surrounding background?
5. Why do we call a grayscale image “colorless” even though it can show many shades from black to white?