Outline

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- What is an Image?
- What is a Digital Image?
- Image Acquisition
- Image Processing Blocks
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Introduction/Course Description

- See syllabus under "Course Documents" on blackboard

What is an image?

- An image is a type of signal
- Is it the signal that we see? Not always correct
- Is it the signal that the light birngs to us? Not always!
- A good description would be that "An image is a signal that carries spatial information"
- Images with time variation can be defined as a "video signal"

Digital vs Analog Image Processing

- Analog image processing is done without digital computing, e.g. optical image processing
- In this class, we will be dealing with digital image processing for most of the part

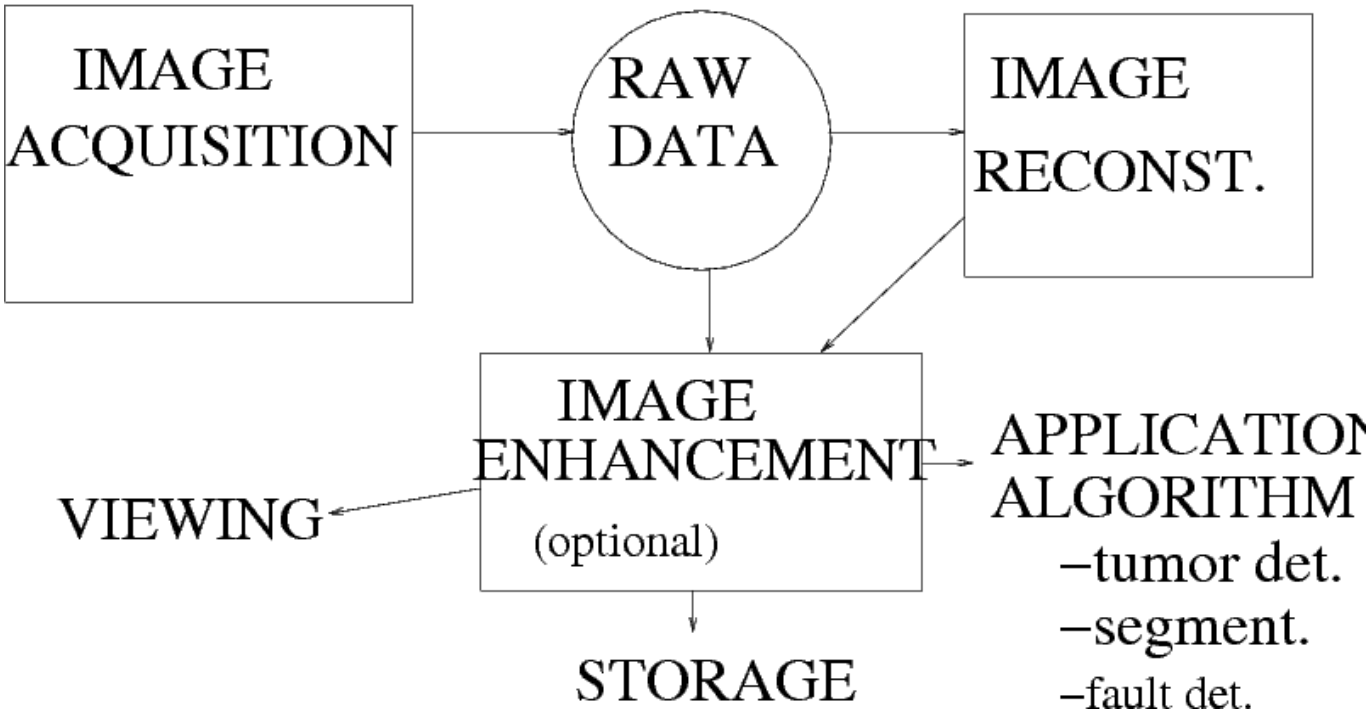
What is a digital image?

- Analog image is sampled to obtain discrete-space images and then the image values are quantized to obtain digital images
- That is, there are two steps in digitizing an image
  - discretize in space, spatial sampling
  - quantize the image amplitude since we use finite number of bits to represent image values

Image Acquisition

- The methods to acquire images include using
  - EM waves, including visible light, radio waves, gamma rays
  - Sound waves
  - Electrons
- Each of these techniques have different applications, advantages, and drawbacks
- The key is to select a technique that is selective to the spatial property that you are interested
- E.g. if you want to image a tumor, then you would like to use a method that distinguishes between the tumor and the healthy tissue, and can penetrate deep into the body so that it can be used non-invasively

Image Processing Blocks



Applications

- Medical Imaging: non-invasive imaging of the body, examples are MRI, CT, PET, SPECT, X-ray. Very useful in e.g. neurological diseases, tumor studies, internal diseases and many more
- Military Applications
- Security Applications: Fingerprint recognition, face recognition, imaging of packages etc.
- Entertainment: photography, video, internet
- Determining natural sources, e.g. oil

A compression example

- Let us say we are dealing with a movie of length 100 minutes
- 5000 sec x 20 frames per second x 20 bits per pixel x 1000 width x 1000 height x 3 colors
- That is approximately 3×10^{12} bits, 3×10^{9}kbits, 3×10^{3} gigabits, 375 gigabytes for one movie!
- Common compression algorithms provide a very high quality movie for 1 gigabytes instead of 375

Human Visual System

- Visible light is processed bye the eye and then the acquired information is sent to the visual cortex
- The eye is surrounded bye three layers: sclera (outer), choroid (middle) and retina (outer). The sclera bacomes transparent and takes the name cornea in front of the lens
- Light passes through the lens and an image is formed on retina
- Two types of cells produce the image: cones and rods. Cones are responsible for details whereas rods provide the general view of the picture
- Then the image produced on the retina is transformed into electrical signals and send to the brain, visual cortex

Human Visual System

- Our eye and visual cortex performs a huge amount of processing on the images that we "see"
- Examples are: low pass filtering, dynamic range adjustment, auto-focus, registration for moving objects, segmentation, recognition, and many more