What Is Imaging Science?

Imaging Science Fundamentals
What is an Image?

Your vacation photo taken with film.

Your x-ray from your doctor.

A program on your television.
What is an Image?

- An image is a visual representation of an “observable”
- An observable is some measurable property of a person, object, or phenomenon.
Images and Object Properties

- **Reflection**: Reflected light captured on light-sensitive material called film.

- **Transmission**: Transmitted x-rays captured on x-ray sensitive material.

- **Reflection**: Reflected light converted to electronic signal that is broadcast, received, then converted back to series of images!
Other phenomena as Images

Temperature map (Temperature)

Ultrasound Imaging (Sound reflection)

Radar (Microwave reflection)
Seeing what your eyes can’t . . .

- Some imaging systems create visual maps of what the eye and mind can see.
- Others serve as transducers, converting what the eye cannot see into a visual representation that the mind can comprehend.
Imaging Systems

Device that creates the image.

- Photograph
- X-ray
- Television

→ Camera, film, processing
→ X-ray machine, film
→ Camera, TV, etc.
Imaging Science

- Includes many scientific disciplines:
  - Mathematics
  - Physics
  - Chemistry
  - Electronics
  - Other specific fields.
The Imaging Chain

6 Stages of Imaging

1. SOURCE: sun, star, light bulb
2. OBJECT: person, flower, car
3. COLLECTION: lens, mirror
4. DETECTION: film, CCD
5. STORAGE: film, computer file
6. OUTPUT: printout, monitor

Imaging systems include at least one step of the imaging chain.
Imaging is Everywhere!

- Applications of imaging technology can be seen almost everywhere.
Astronomy: “Zooming in”

The constellation of Orion (wide-field)

The Orion Nebula (Hubble Space Telescope)
Astronomy: the whole spectrum

- Milky Way is the galaxy where our solar system is located.
- Different regions of the electromagnetic spectrum allow astronomers to detect diverse phenomena in the universe.
Three views of young stars in Orion

Orion Nebula region
left: optical
center: infrared
right: Xray
Remote Sensing - Defense

Visible and infrared wavelengths show visual details as well as heat signatures of aircraft and other objects.

Image from Digital Globe
Satellites can monitor protected forests for illegal logging activities.

Images from space show depletion of ozone from the south pole.

Images from Digital Globe and NASA
Meteorology

Meteorologists use a variety of image data to predict weather patterns, as well as represent data as images.

- Satellite based visible image showing cloud cover.
- Ground based Doppler radar showing precipitation.
- Ground based temperature data also can be shown as an image.

Images from The WeatherChannel
Ancient documents can be made legible by various imaging techniques.
Medical imaging is used every day to provide physicians with useful data for better patient care.

Images from The Visible Human and Siemens
Commercial/Personal

- Photography
- Printing
- Desktop publishing
In Summary

- An image is a visual representation of person, object, or phenomenon.
- Imaging systems create images.
- Imaging systems record what we see, or what we cannot see.
- Imaging is everywhere!