PAM3012
Digital Image Processing for Radiographers

Introduction

Aim of this Module

- Integrate theory with practice; re-interpret knowledge of imaging within a mathematical and scientific framework.
- Develop a level of mathematical skill sufficient to analyze complex waveforms
- Statistical consequences of the information stored in an image.
- Develop knowledge of the algorithms used for image manipulation and how these affect the image.
- Learn how each component of the imaging chain affects the diagnostic capabilities of a method.

Module Specific Skills

- Show that complex waveforms can be decomposed into sinusoidal waveforms;
- Discuss the implications of image perception for medical imaging;
- Quantify predictive diagnostic imaging capability using various mathematical concepts;
- Solve complex problems involving digital imaging systems;
- Identify causes of noise in digital imaging systems and methods of minimisation;
- Predict the performance of a digital imaging systems from it's specifications;
- Show that how various image manipulation algorithms can improve the diagnostic quality of an image;
- Discuss applications of image coregistration.

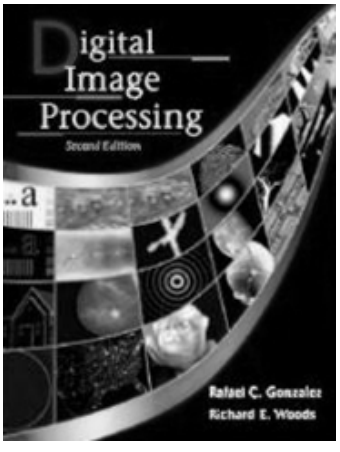
Teaching

- Lectures: 21 X 50 mins
- Practical Classes: 3 x 3 hours

Assessment

- Practical Classes
  - 10%
- Examination
  - 90%
  - 2 Hours
  - Section A all ten questions
  - Section B choose two of three questions

Text Book

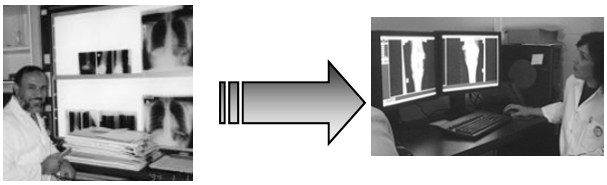


Introduction to DIP

★What is Digital Image Processing
★The Digital Image
★Historical perspective
★Modern applications
★Fundamental Steps
★Overview of typical components

Digital Image Processing

- The future of wet processing?



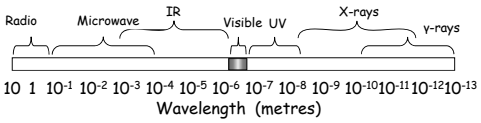
What is Digital Image Processing?

Digital image processing stems from two principle applications

1. Improvement of pictorial information for human interpretation
2. Processing image data for storage, transmission and representation for autonomous machine perception

What is Digital Image Processing?

- Vision is the most advanced of our senses
  - Restricted to small region of EM spectrum
- Imaging machines
  - Cover entire range: Gamma to Radio



Digital Image

An image can be defined as a two-dimensional function *f(x, y)*

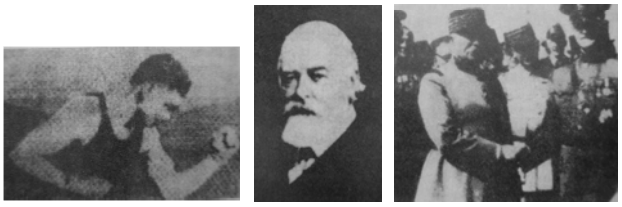
x and y are spatial (plane) coordinates

f, the amplitude at any pair of coordinates is called the intensity or grey level of the image at that point

History

- First application 1920s: Newspaper Industry

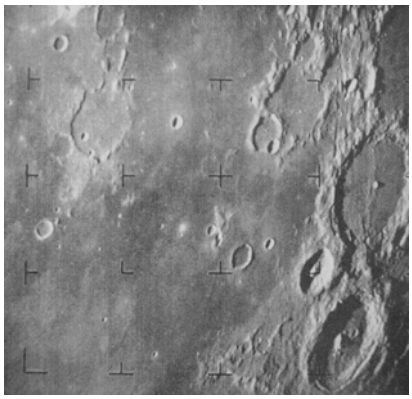
Bartlane Cable Transmission



1920 1921 1929

History

1960's
- Computers
- Space Race



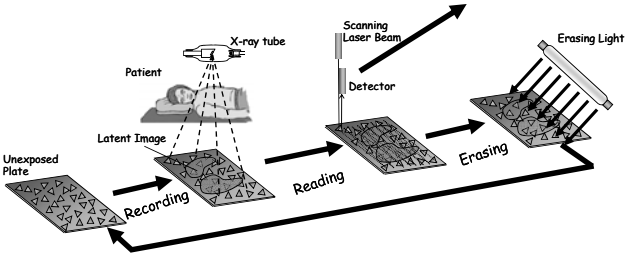
1964 *Ranger 7*

Modern Applications

- DIP used to produce visible image from invisible radiation
- EM spectrum: Gamma -> Radio
- Other sources of radiation?

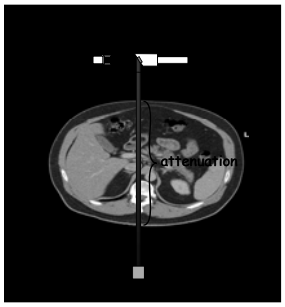
X-Ray Imaging (CR)

- Phosphor stores x-ray energy
- Read plate by scanning with laser
- Digital image produced on monitor



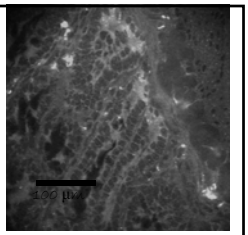
X-Ray Imaging (CT)

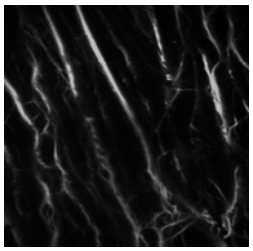
- Total attenuation between tube & detector
- Sum of attenuation coefficients in all voxels beam has travelled through
- A measure of how rapidly x-ray are absorbed along line within material
- Goal: To calculate attenuation within each individual voxel



My Interest in DIP

- Optical Imaging



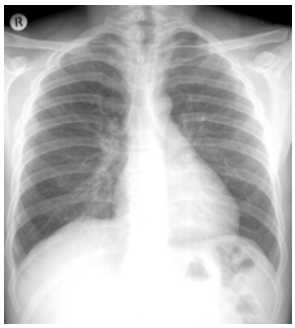


Fundamental Steps

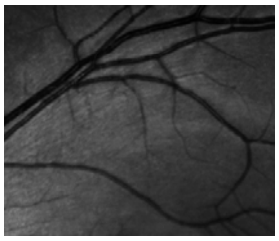
- Image Acquisition
- Processing
  - Image Enhancement
  - Image Restoration
- Classification & Diagnosis

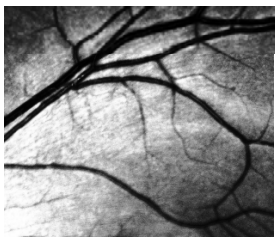
DIP in Radiography

- Why does a radiograph look like this?
- Image formation

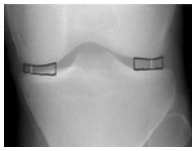


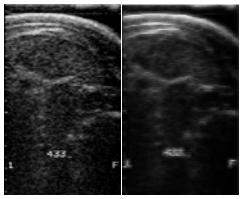
Contrast Enhancement





Edge detection





3D Reconstruction

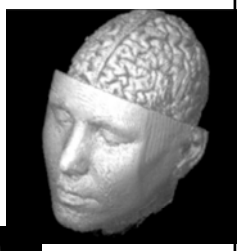
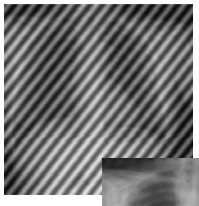
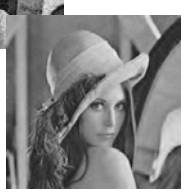
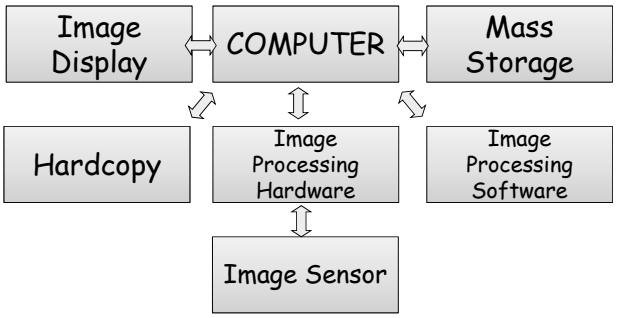


Image Restoration





Components



Diagnosis?

- Does Enhancement & Restoration improve diagnosis?

Summary

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