Lecture 10 – part 1,

Medical Image Analysis and Programming Tools

No suggested problem...

Magnus Gedda magnusg@cb.uu.se
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Medical Image Processing

• Medical imaging
  – X-Ray, CT
  – Ultrasound
  – MRI
  – PET, SPECT

• Generic problems
  – Enhancement
  – Registration
  – Segmentation
  – Interpretation

• Visualization
  – MPR, MIP
  – Surface and Volume rendering
Images are acquired to get information about anatomy and physiology of a patient.
Image types

US

MRI

PET

CT
Use of X-Rays

1901

1975

2000
X-Ray Technique
Pulmonary
Musculo-skeletal
Angiography
Mammography
CT – Computed Tomography
CT Technique
Skeleton
Abdominal
Angiography
US - Ultrasound
Cardiac imaging
Abdominal

Liver / hepatic veins
Angiography
Gynecology Obstetrics
PET – Positron Emission Tomography
PET Technique
Examples
SPECT - Scintigraphy
MR – Magnetic Resonance
Musculo-skeletal (joints)
Neurological

Multiple sclerosis
Angiography
Angiography
Abdominal
Cardiac
Other medical imaging modalities

- Microscopy
Generic problems in medical imaging processing

- Enhancement
- Registration
- Segmentation
- Interpretation
Enhancement

• **Noise (e.g. MRI)**
  – Requires good knowledge of imaging physics
  – And a good approximation algorithm
Enhancement

• **Background**
  – E.g., MRI
  – Field variations produce non-uniform background
  – Corrected by fitting a low-order polynomial to the image
Registration

• Matching 2 volumes by applying geometric correction to one of them
• The need for registration
  – Study over time
  – Fusion of different imaging modalities
  – Matching to an atlas
  – Organs movement
Segmentation

• The need for more sophisticated algorithms
  – Deformable models
  – Watershed
  – Level set methods
  – Fuzzy connectedness

=> Image Analysis MN2
Interpretation

- Labeling from segmentation result
- Top-down image analysis
- Expert systems

=> Artificial Intelligence
Visualization of medical images

• 2D

• 3D
  – (Multi-planar reconstruction)
  – Maximum intensity projection
  – Surface rendering
  – Volume rendering
Maximum intensity projection
Shade surface display (SSD)

- Preliminary segmentation
- Voxel set => surface
- Surface elements rendered according to illumination model
- Optional to texture
Volume rendering

• Reflection/transmission properties assigned to each voxel
The Visible Human Project
Perspective

• **Fusion of techniques (MR, CT, PET, ...)**
  – Dual imaging devices
  – Image processing

• **Real-time imaging/Virtual surgery**

• **Higher power, but tougher problems**

• **Complete automation unattainable**
  – Good interaction more feasible