Medical Image Analysis (MIA)

Master VIBOT

2016-2017

Robert Martí

Presentation

- Lecturer:
  - Robert Martí (robert.marti@udg.edu)

- 5 ECTS
  - Theory & Discussions
  - Labs (Computer Vision Lab)
  - Final Project: report, lab, presentations.

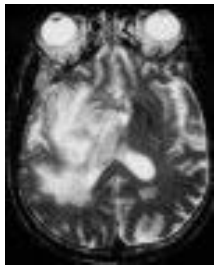
Medical Image Analysis

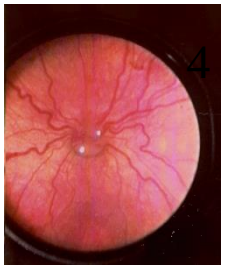
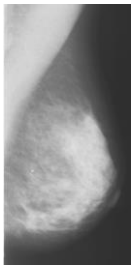
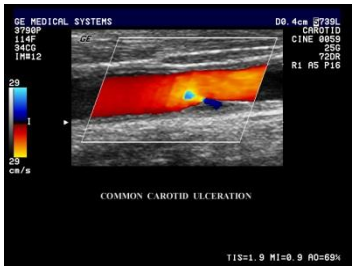
Syllabus

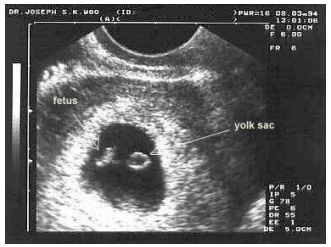
Robert Martí

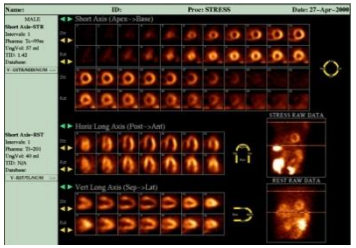
Medical Image Analysis

- Increasing number of digital images in medical applications
  - Digital Systems (mammography, MRI, Ultrasound)
  - Screening programs for diseases in many countries
  - Volumes of thousands of images to be read per radiologist

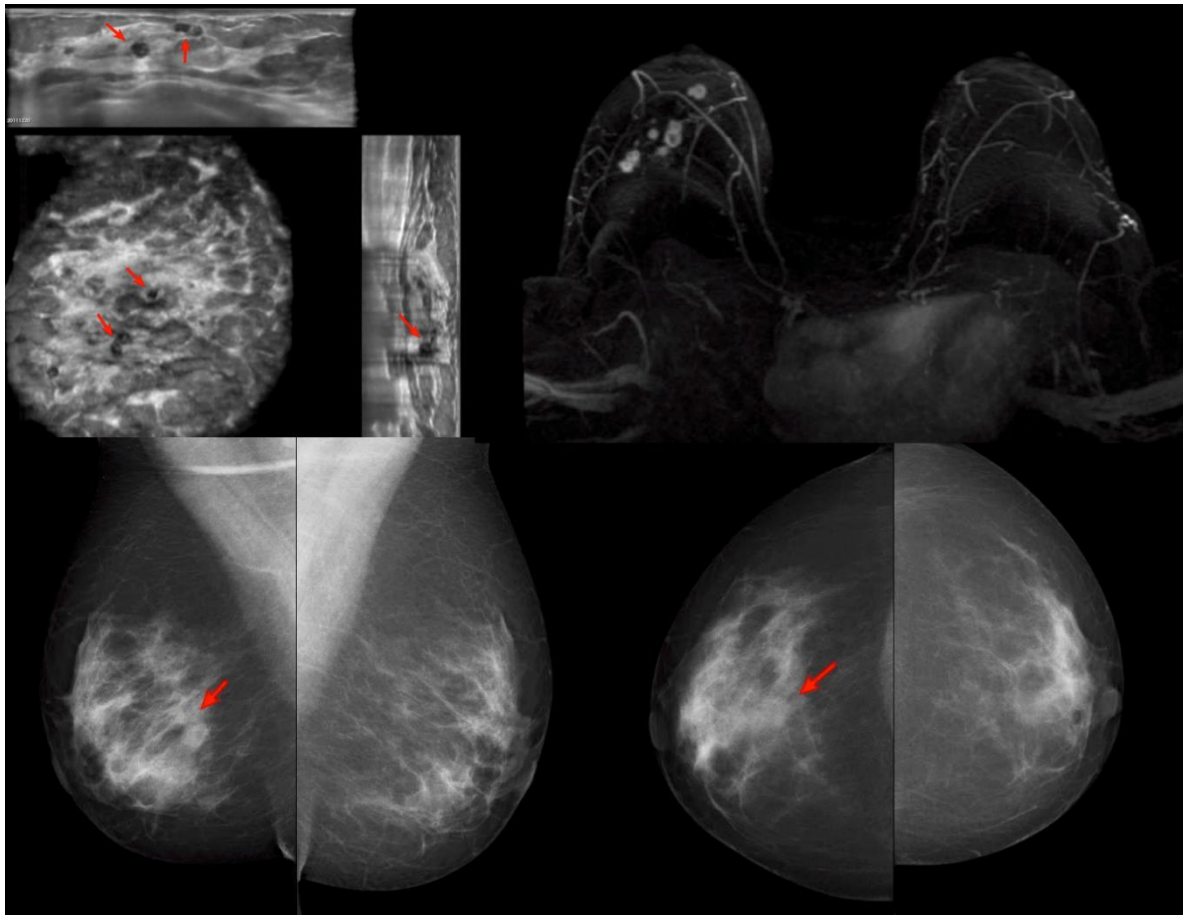






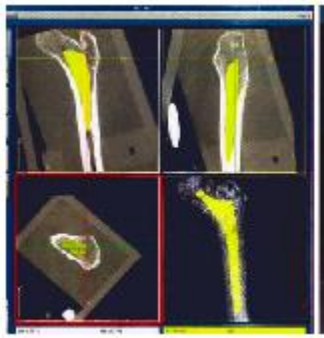

Medical Image Analysis

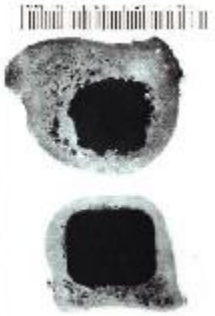
- Need of tools to assist doctors in…
  - Detection and Diagnosis (Where & What do I have?)

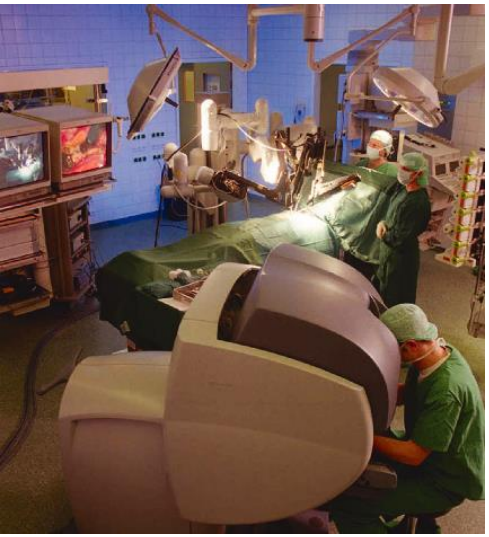


Medical Image Analysis

- Need of tools to assist doctors in…
  - Surgery (Remove what I have!)

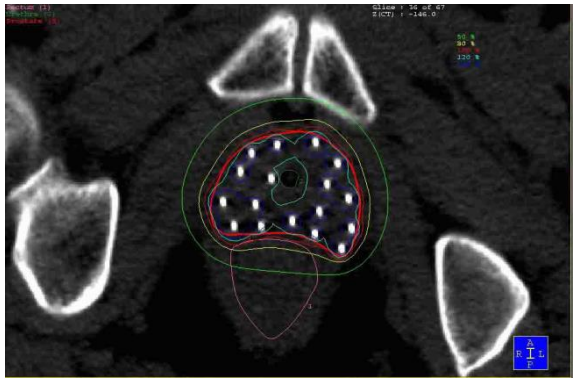


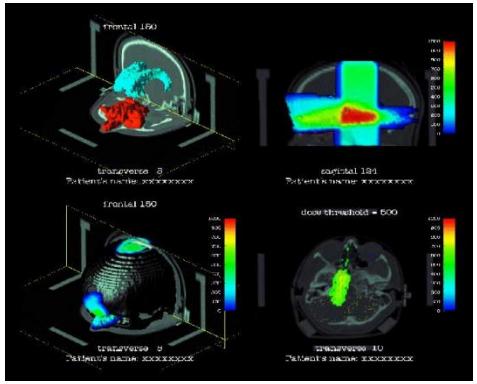



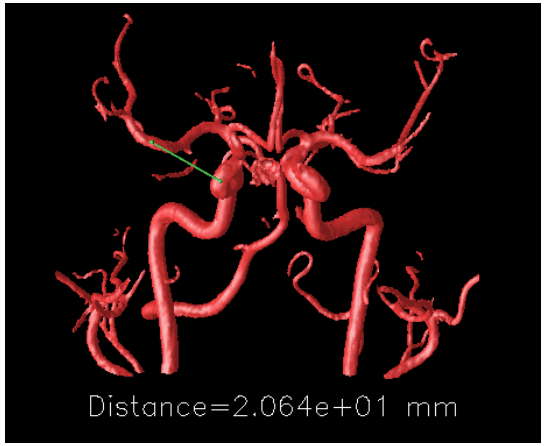


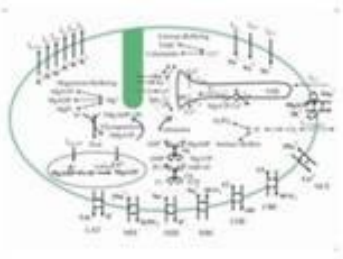

Medical Image Analysis

- Need of tools to assist doctors in…
  - Therapy/Treatment & follow up (remedy what I have!)



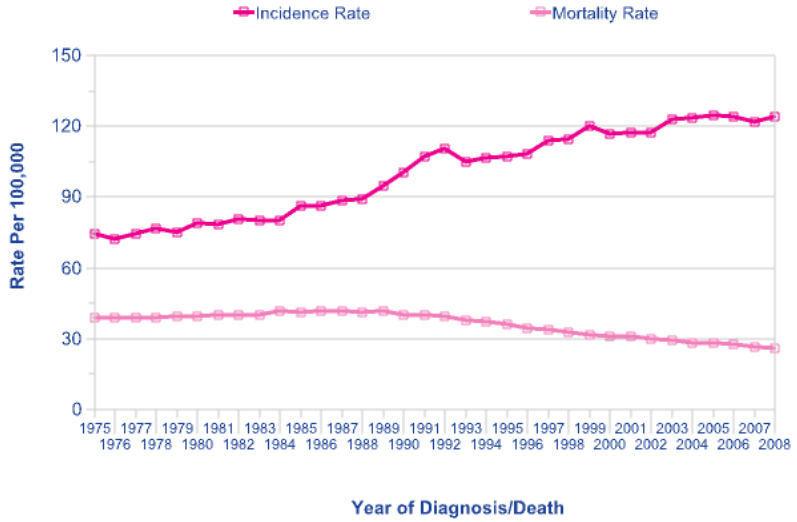






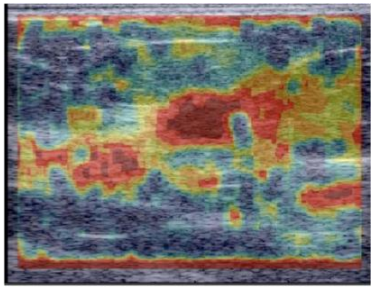
Medical Image Analysis

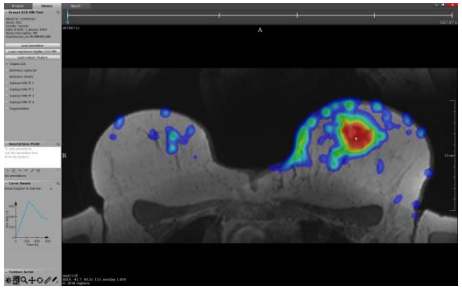
- We ain't no doctors!
  - Multidisciplinar research
  - Motivated by doctors but powered by computer vision, image analysis and pattern recognition
  - Applicability to real world problems
    - CAD in mammography can help to reduce mortality?

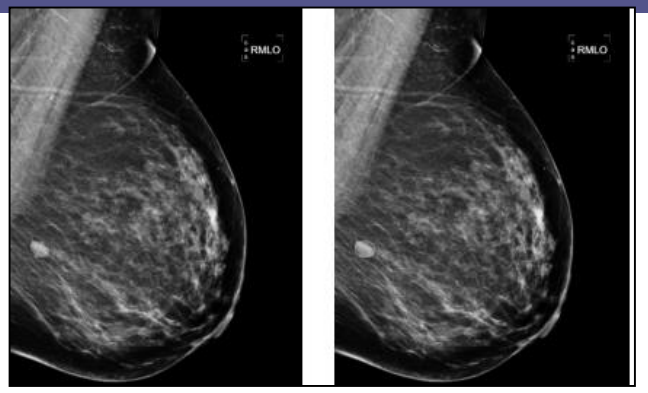


Medical Image Analysis @ VICOROB

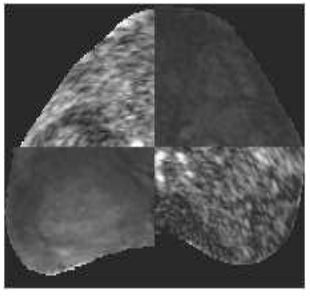
- Breast:

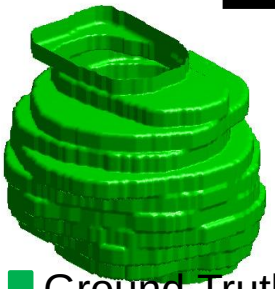






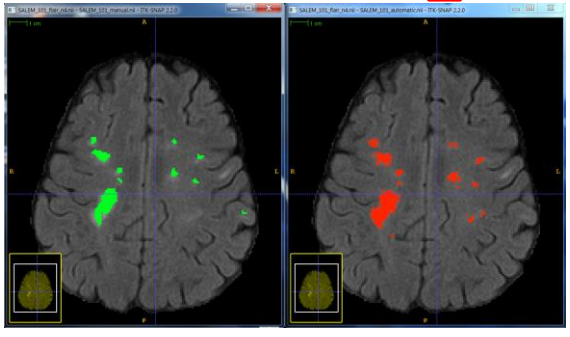
- Prostate



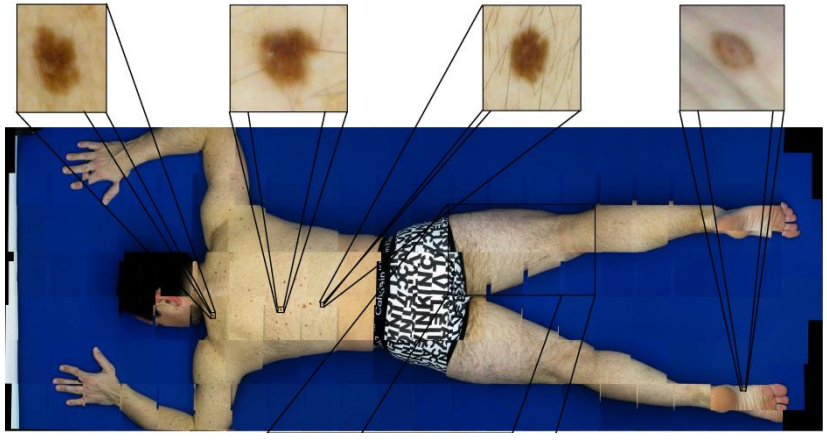


Segmentation Ground Truth

- Brain:



- Skin: Melanoma



Course Outline

1. Medical Image Analysis

1.1. Introduction

1.2. Image Formats and description

1.3. Image Modalities

1.4. CAD / CARS

1.5. Evaluating your algorithm

2. Image Pre-processing

3. Image segmentation

3.1. Active contour methods

3.2. Shape modelling

3.3. Applications

4. Image registration

4.1. Overview

4.2. Rigid and non-rigid registration

4.3. Atlas based image segmentation

4.4. Applications

Evaluation

- Final Mark (FM):
  - Lab sessions (Lab)
  - Final Project (FP). Lab work + report + oral presentation.
  - FM = 0.3 Labs + 0.4 FP + 0.3 Exam

- Plan your deadlines!
  - 100 % mark before the deadline
  - 80 % up to a week after
  - 50 % more than a week after

Lab sessions

- Labs start the 17th February 2017
- Computer Vision Lab
- Friday 10:00 – 12:00.
- Lab Assistants: Robert Martí
- Guided Lab sessions
- **Groups of 2.**
- Plagiarism will be prosecuted, cite your sources of information.

Lab sessions (ii)

- Topics (4 labs)
  - Image modalities and pre-processing with Matlab (1w)
  - Medical Image Analysis prototyping using Mevislab (1w)
  - Image segmentation: algorithms and evaluation (2w)
  - Image registration with ITK and C++ (2w)

- Deliverables
  - Source code (Good programming practice!)
  - Demonstration
  - Short report (2-3 pages) regarding problems, results and conclusions.

Lab sessions (iii)

Lab 1. Image modalities using MATLAB (1 w)

Loading and understanding image formats and characteristics (i.e. dimensionality, depth).

Lab 2. Medical Image Analysis using Mevislab (1w)

Understanding basic filters in Mevislab

Lab 3. Evaluating image segmentation (2 w)

Evaluate various image segmentation algorithms in a given problem (breast ultrasound)

Lab 4. Image registration in ITK (2 w)

Understand the basics of image registration and the implementation using ITK

Final Project. Challenge!

- Breast density estimation in DBT & Mammography
  - Estimate the breast density in DBT and Mammograhic images
  - Compare to existing state of the art
  - Choose your own implementation
  - Mevislab / ITK / Matlab

- Evaluation Criteria
  - Accuracy
  - Robustness
  - Methodology
  - Computational time

Final Project

- Supervision and follow up
  - Friday 31th March 10:00- 12:00 (CV Lab)
  - Friday 28th April 10:00 – 12:00 (CV Lab)
  - Submission deadline
    - 17th May: oral presentations
    - 24th May: source code + report
  - Challenge day: 24th May
  - Submission
    - Presentation (ppt, odps)
    - Code and executable.
    - Report in paper format (latex).

Bibliography

- *Machine Vision, Wesley E. Snyder & Hairong Qi*
- *Insight into Images: Principles and Practice for Segmentation, Registration and Image Analysis, Terry S. Yoo (Editor)*
- *Handbook of Medical Imaging: Processing and Analysis, Isaac Bankman (Editor)*
- *Computer Vision, Linda Shapiro*
- *Algorithms for Image Processing and Computer Vision, J. R. Par*
- *Gonzalez and Woods. Digital Image Processing. Prentice Hall. 2nd Edition, 2002.*
- Fundamentals of Medical Imaging, P. Suetens, Cambridge University Press 2002
- Biomedical Signal and Image Processing, Najarian and Splinter, 2006
- Biomedical Image Analysis, Rangaraj M. Rangayyan, 2004
- Medical Imaging Signals and Systems, Jerry L. Prince, Jonathan Links, Prentice Hall, 2006
- Medical Image Analysis, A. Dhawan, Wiley 2003
- Foundations of Medical Imaging, Cho, Jones, Singh, John Wiley & Sons, 1993
- *Related Journals and Conferences: IEEE Transactions on Medical Imaging, Medical Image Analysis,* IEEE Transactions on Information Technology in Biomedicine, MICCAI (Medical Image Computing and Computer Assisted Intervention) Conference, IEEE Int. Symposium on Biomedical Imaging (ISBI), SPIE Medical Imaging Conference, CARS (Computer Assisted Radiology) Conference, …

Course Planning

8 Feb: Introduction to MIA and Image Formats (Robert)

15 Feb: Medical Image Modalities (Robert)

22 Feb. CAD / CARS & Algorithm Evaluation (Robert)

1 March: Pre-processing (Robert)

8 March: Seminar Dr. Oliver Díaz.

15 March: Segmentation. ASM (Robert)

22 March: No teaching / Seminar Deep Learning

29 March. Segmentation. ASM (Robert)

5 April. Intro Image registration (Robert)

12 April: No teaching Eastern holidays.

19 April. Seminar on Deep Learning (Prof. J. Vitrià from UB)

26 April: Image Registration. Rigid and non-rigid methods (Robert)

3 May: Atlas based segmentation (Robert)

10 May: Final considerations, Exam and FP follow-up (Robert).

17 May: Student Presentations Final Project. (Robert)

24 May: Challenge day (Robert)

Timetable 2017