

# Medical Image Analysis (MIA)

Master VIBOT  
2017-2018

# Presentation

2

- Lecturer:
  - ▣ Robert Martí (robert.marti@udg.edu)
  
- 5 ECTS
  - ▣ Theory & Discussions
  - ▣ Labs (Computer Vision Lab)
  - ▣ Final Project: report, lab, presentations.

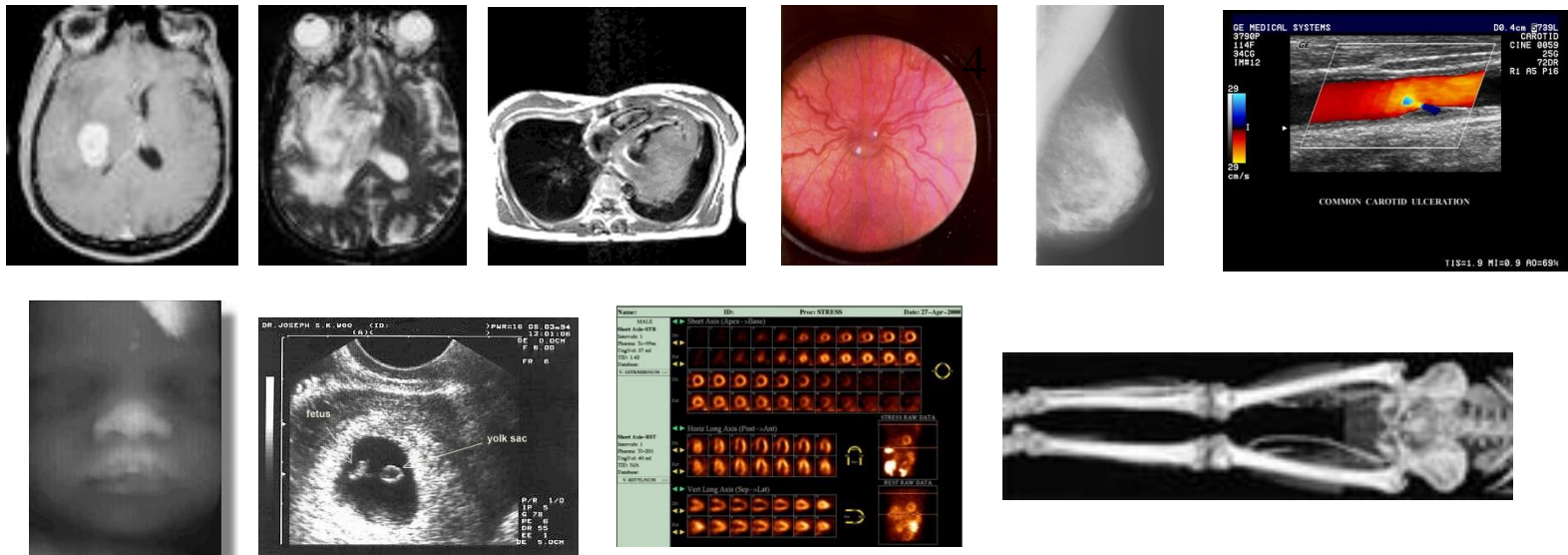
# Medical Image Analysis

## Syllabus

# Medical Image Analysis

4

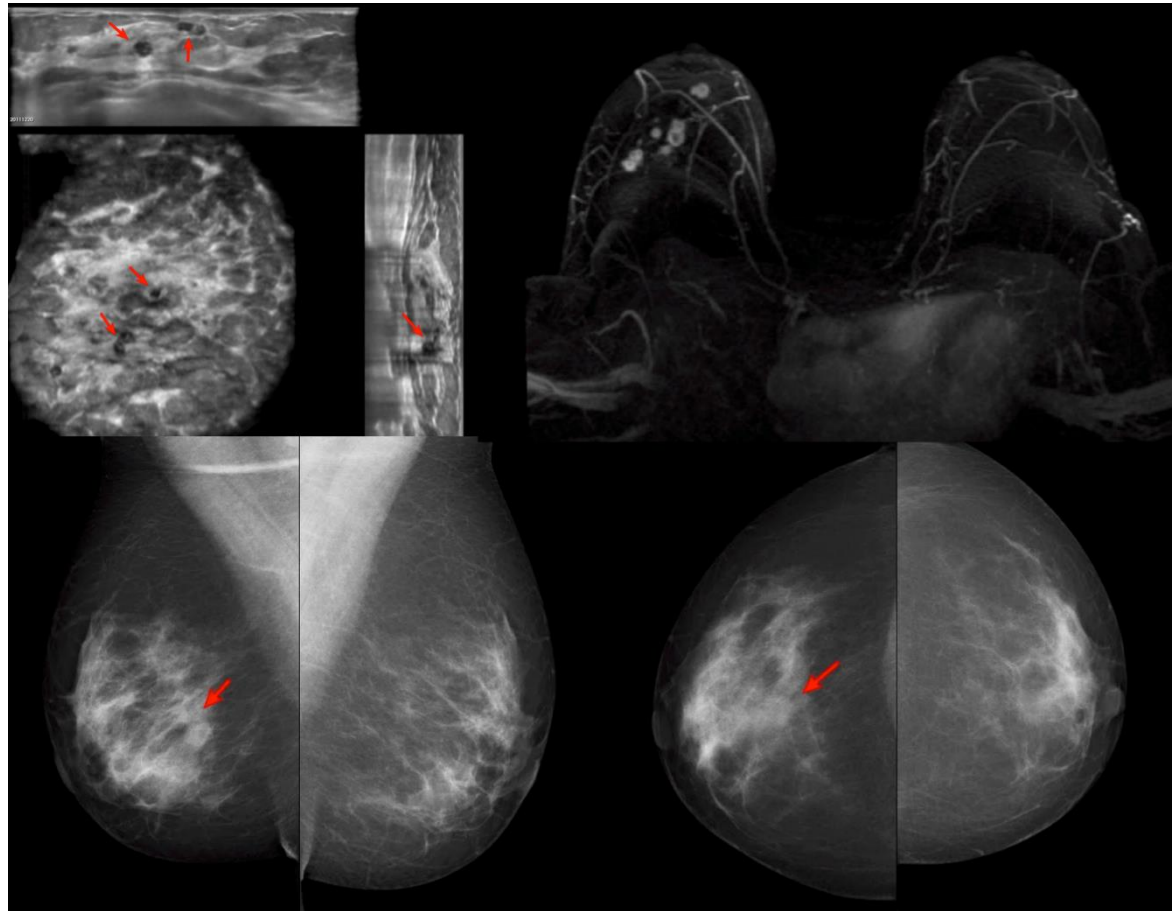
- Increasing number of digital images in medical applications
  - ▣ Digital Systems (mammography, MRI, Ultrasound)
  - ▣ Screening programs for diseases in many countries
  - ▣ Volumes of thousands of images to be read per radiologist



# Medical Image Analysis

5

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



# Medical Image Analysis

6

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

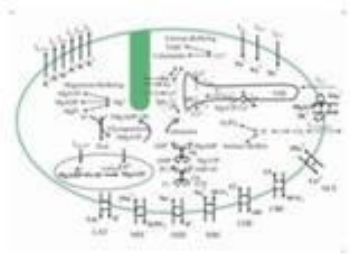
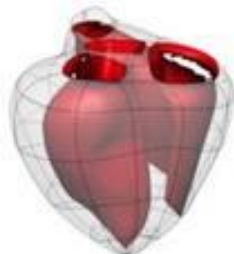
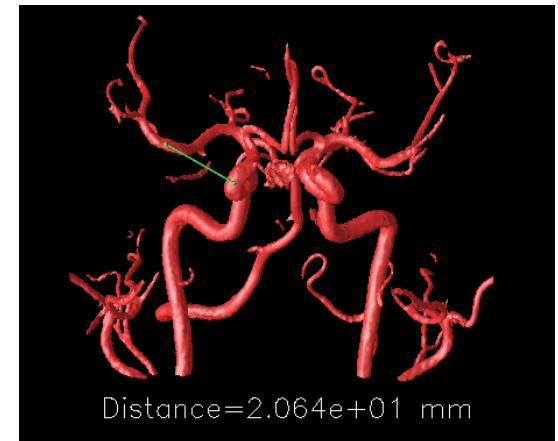
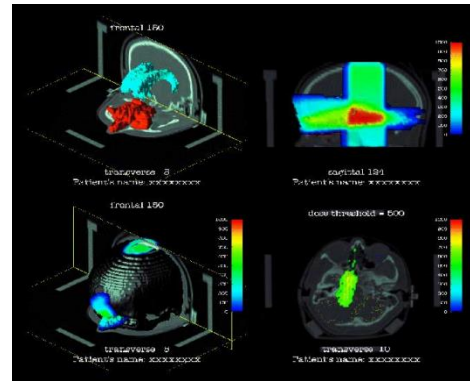
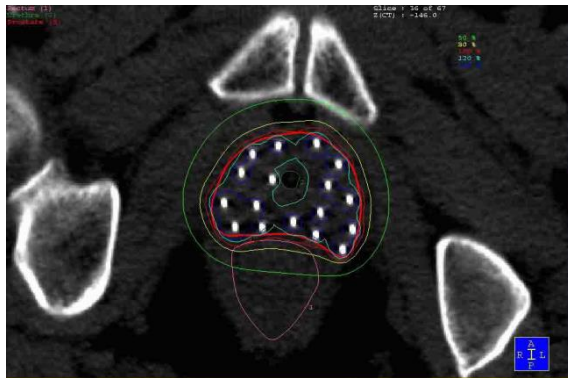




# Medical Image Analysis

7

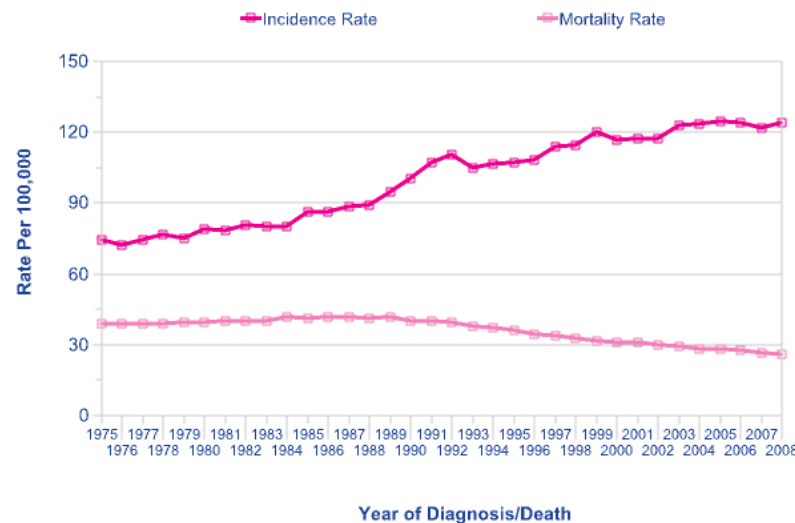
- Need of tools to assist doctors in...
  - ▣ Therapy/Treatment & follow up (remedy what I have!)



# Medical Image Analysis

8

- We ain't no doctors!
  - ▣ Multidisciplinary 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?

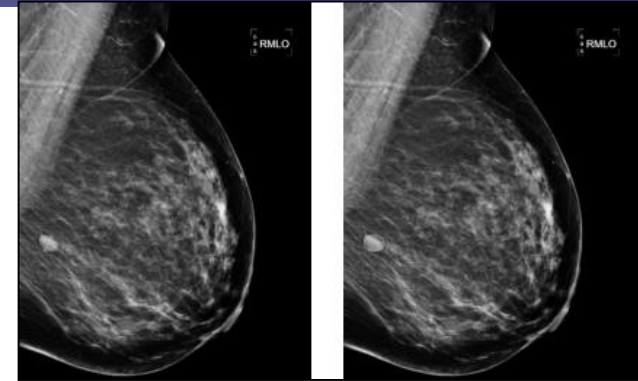
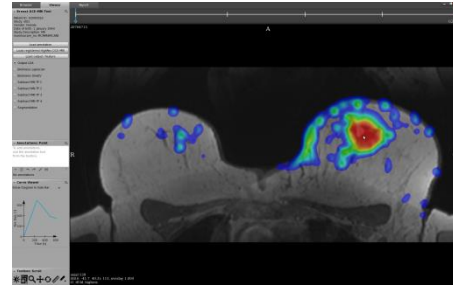
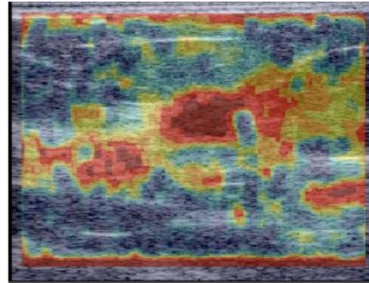




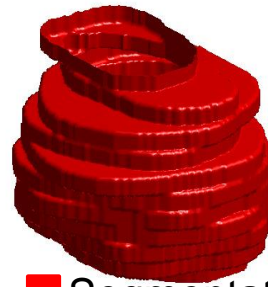
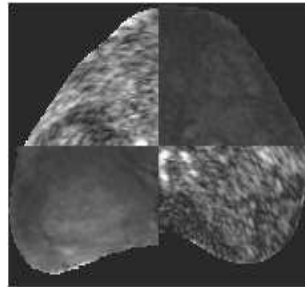
# Medical Image Analysis @ VICOROB

9

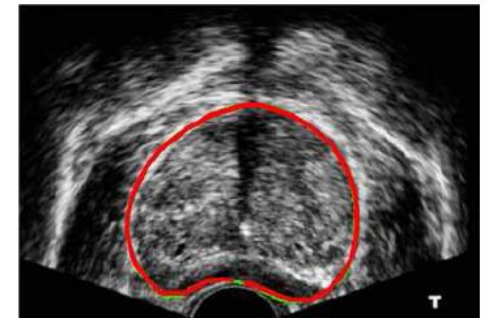
## ■ Breast:



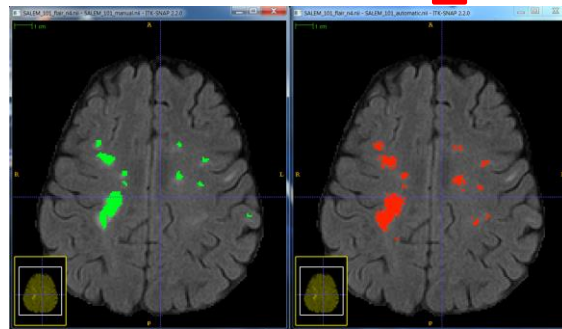
## ■ Prostate



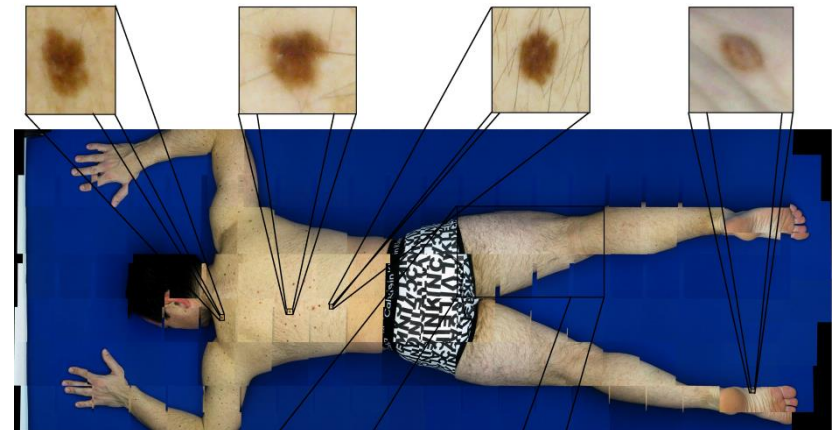
■ Segmentation ■ Ground Truth



## ■ Brain:



## ■ Skin: Melanoma



# Course Outline

10

## 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

11

- Final Mark (FM):
  - ▣ Lab sessions (Lab)
  - ▣ Final Project (FP). Lab work + report + oral presentation.
  - ▣  $FM = 0.3 \text{ Labs} + 0.4 \text{ FP} + 0.3 \text{ Exam}$
  
- Plan your deadlines!
  - ▣ 100 % mark before the deadline
  - ▣ 80 % up to a week after
  - ▣ 50 % more than a week after

# Lab sessions

12

- Labs start the 23<sup>rd</sup> February 2018
- Computer Vision Lab
- Friday 10:00 – 12:00.
- Lab Assistants: Richa Agarwal / Robert Martí
- Guided Lab sessions
- **Groups of 2.**
- Plagiarism will be prosecuted, cite your sources of information.

# Lab sessions (ii)

13

- Topics (4 labs)
  - ▣ Image modalities and pre-processing with Matlab (1 w)
  - ▣ Medical Image Analysis prototyping using Mevislab (1 w)
  - ▣ Image segmentation: algorithms and evaluation (2w)
  - ▣ Image registration with Matlab (2w)
  
- Deliverables
  - ▣ Source code (Good programming practice!)
  - ▣ Demonstration
  - ▣ Short report (2-3 pages) regarding problems, results and conclusions.

# Lab sessions (iii)

14

## **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 (1 w)**

Understanding basic filters in Mevislab

## **Lab 3. Evaluating image segmentation (2 w)**

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

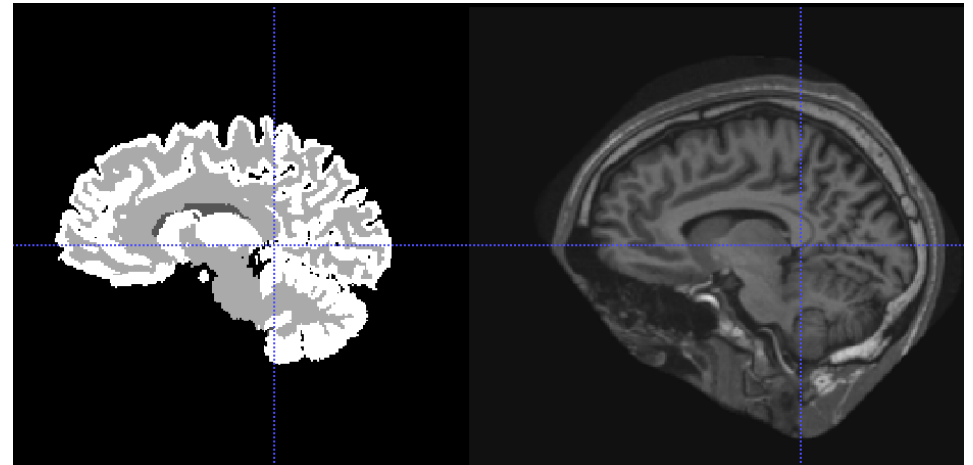
## **Lab 4. Image registration in Matlab (2 w)**

Understand the basics of image registration and the implementation using Matlab

# Final Project. Challenge!

15

- Atlas based segmentation of brain images.
- Choose a clustering algorithm and build an atlas for improving the segmentation.
- Evaluation Criteria
  - ▣ Accuracy
  - ▣ Robustness
  - ▣ Methodology
  - ▣ Computational time





# Final Project

16

- Supervision and follow up
  - ▣ Friday 20<sup>th</sup> April 10:00- 12:00 (CV Lab)
  - ▣ Wednesday 2nd May 12-14 (teaching room)
  - ▣ Submission deadline
    - 16<sup>th</sup> May: oral presentations
    - Week of 21<sup>st</sup> May (TBC): source code + report
  - ▣ Challenge day: Week of 21st May (TBC)
  - ▣ Submission
    - Presentation (ppt, odps)
    - Code and executable.
    - Report in paper format (latex).

# Bibliography

17

- *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

18

12 Feb: Introduction to MIA and Image Formats (Robert )  
19 Feb: Medical Image Modalities (Robert)  
28 Feb. CAD / CARS & Algorithm Evaluation (Robert )  
7 March: Pre-processing (Robert)  
14 March: Pre-processing (Robert)  
21 March: Intro Image registration (rob)  
4<sup>th</sup> April : no teaching  
9 -11 April. Seminar Deep Learning F. Ciompi SSI & MIA. (10h )  
18 April: Atlas segmentation  
25 April: Image Registration. Non-rigid methods (Robert)  
2 May: FP follow up  
10 May: No teaching work on FP.  
17 May: Student Presentations Final Project. (Robert)  
24 May: Challenge day (Robert)

(Active shape segmentation)

(Non-rigid image registration)

# Timetable 2018

19

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març 2018						
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L2

L3

L3

L4

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L4

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