



# Medical Images - Segmentation

## Lecture 11

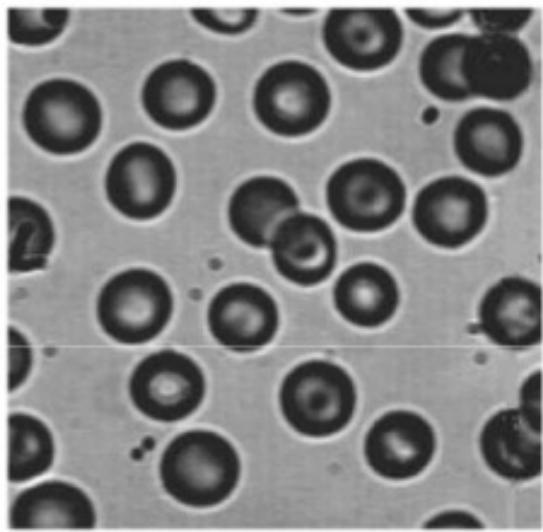
Waqas Sultani  
Information Technology University

# Image Segmentation

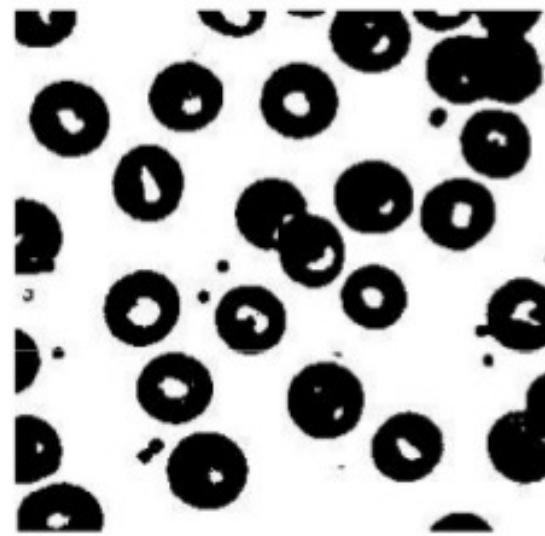
- Automatic Image Segmentation
  - Kmeans
  - Agglomerative
  - Meanshift
  - Superpixel Segmentation
  - Graph Cut
  - Watershed Segmentation
- Interactive Image Segmentation
  - Grab Cut Segmentation
  - Active Contours



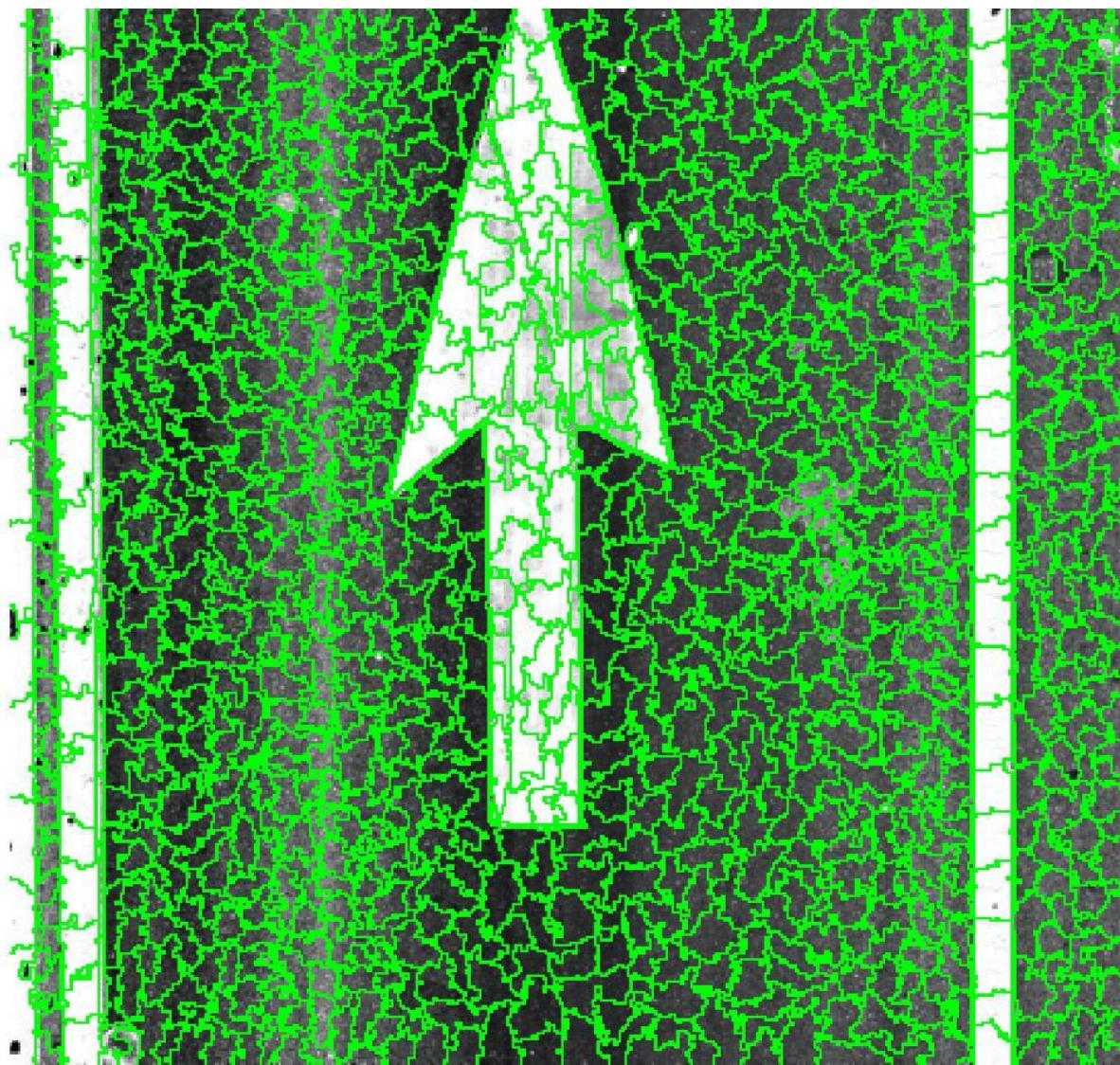
# Graph-Cut Segmentation

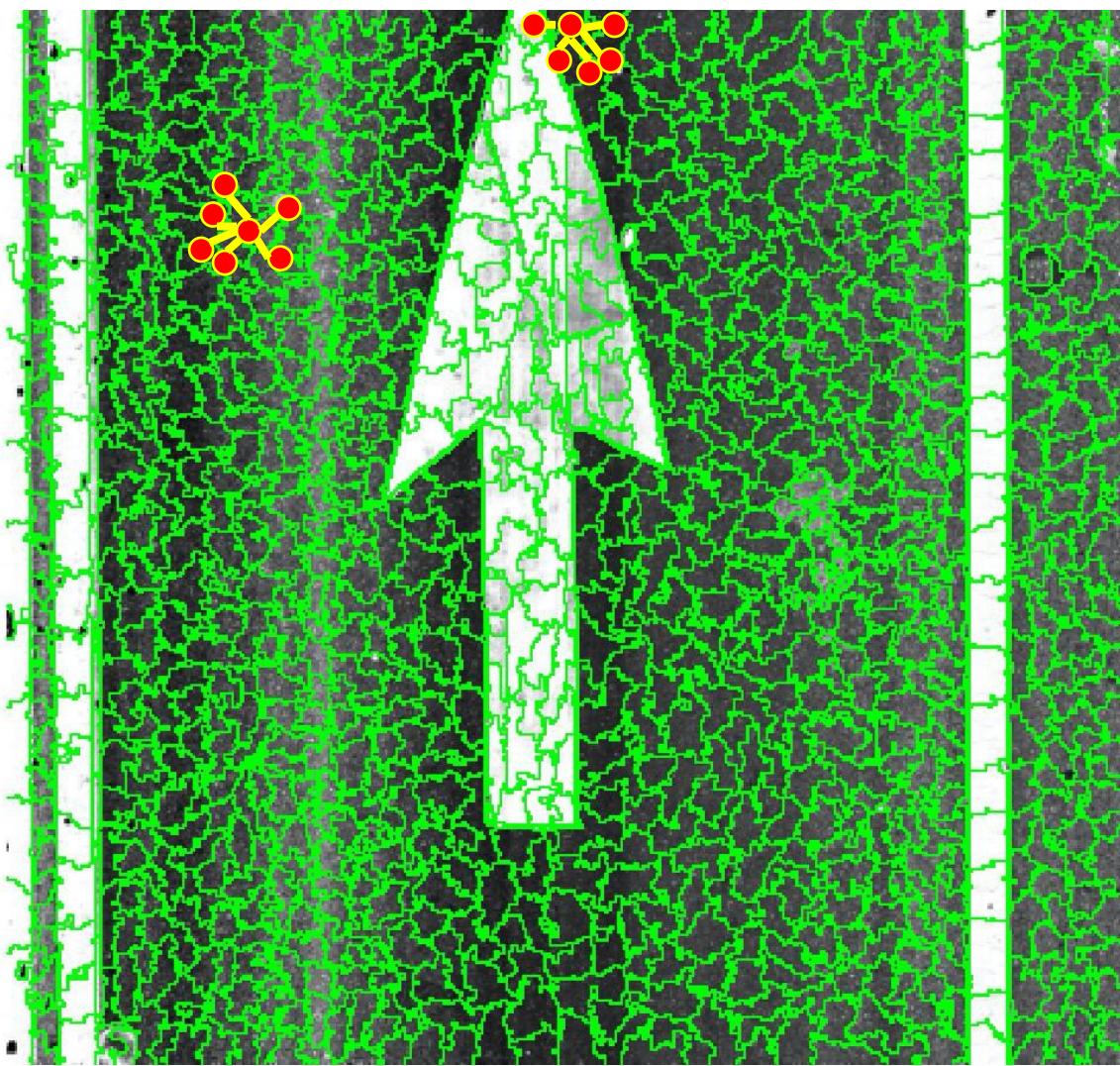


Red Blood Cells Grayscale Image

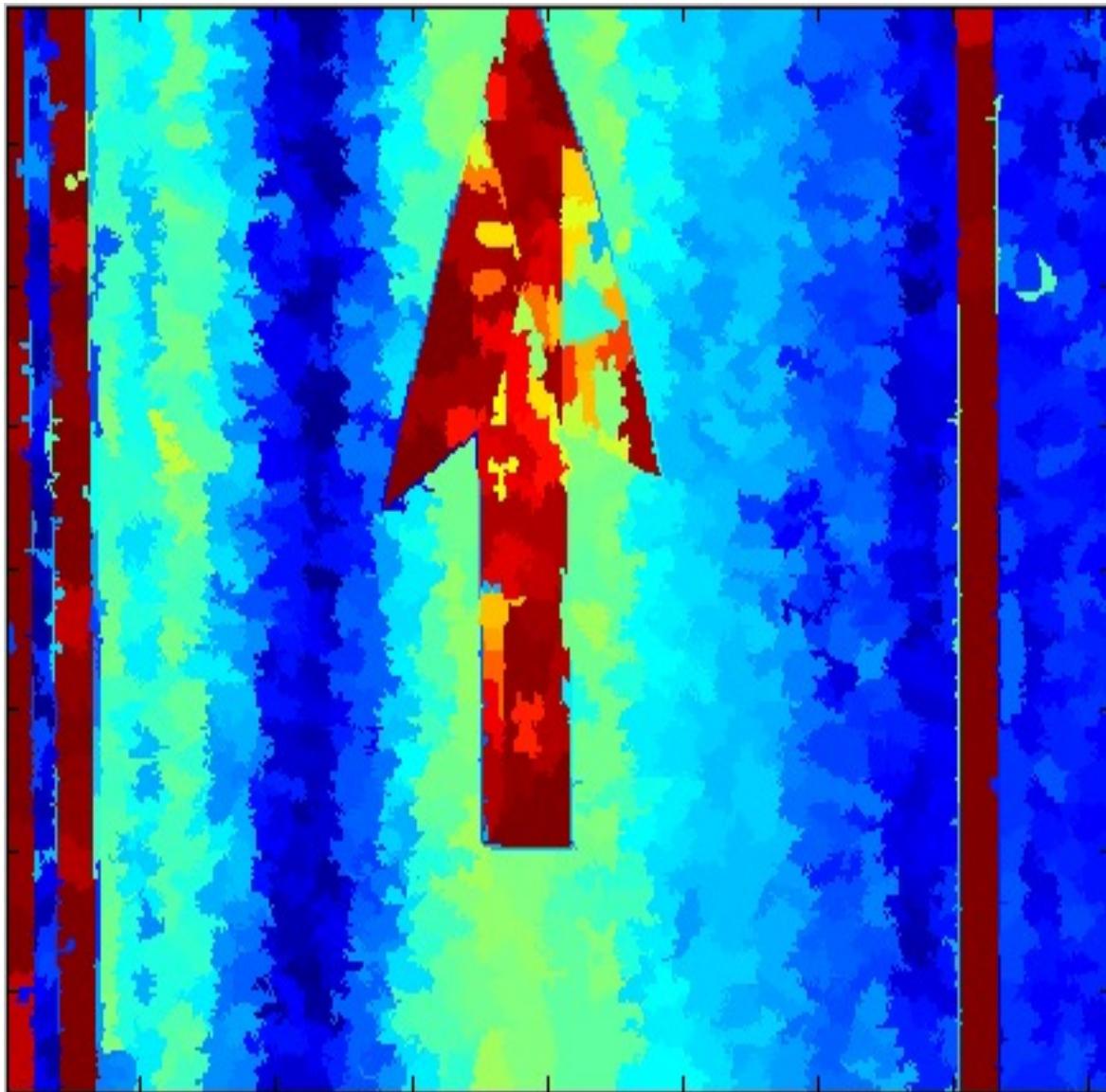


Red Blood Cells Binary Image



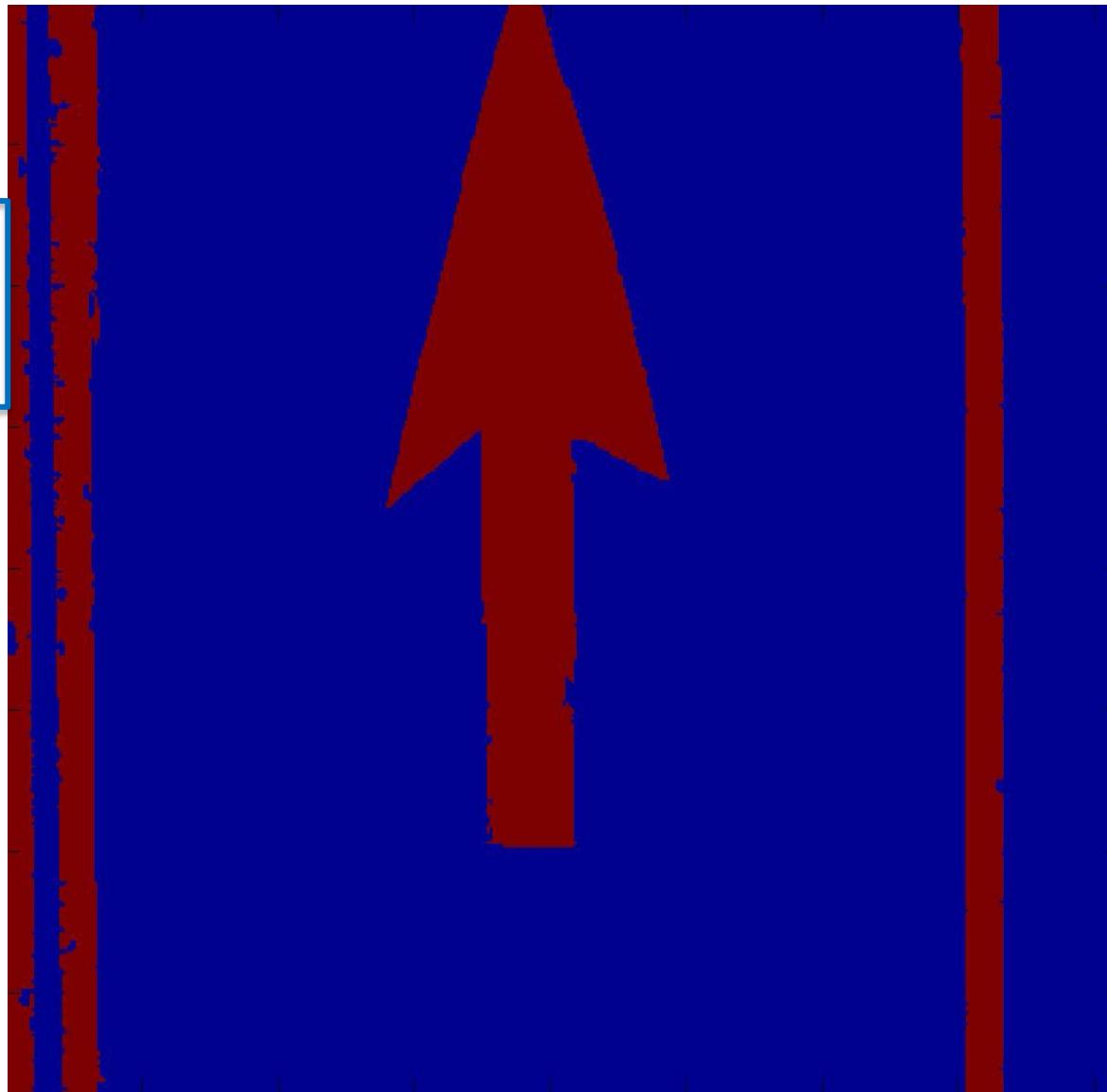


Superpixel  
Object label



Superpixel  
Object label

Incorporate  
Neighborhood  
Information



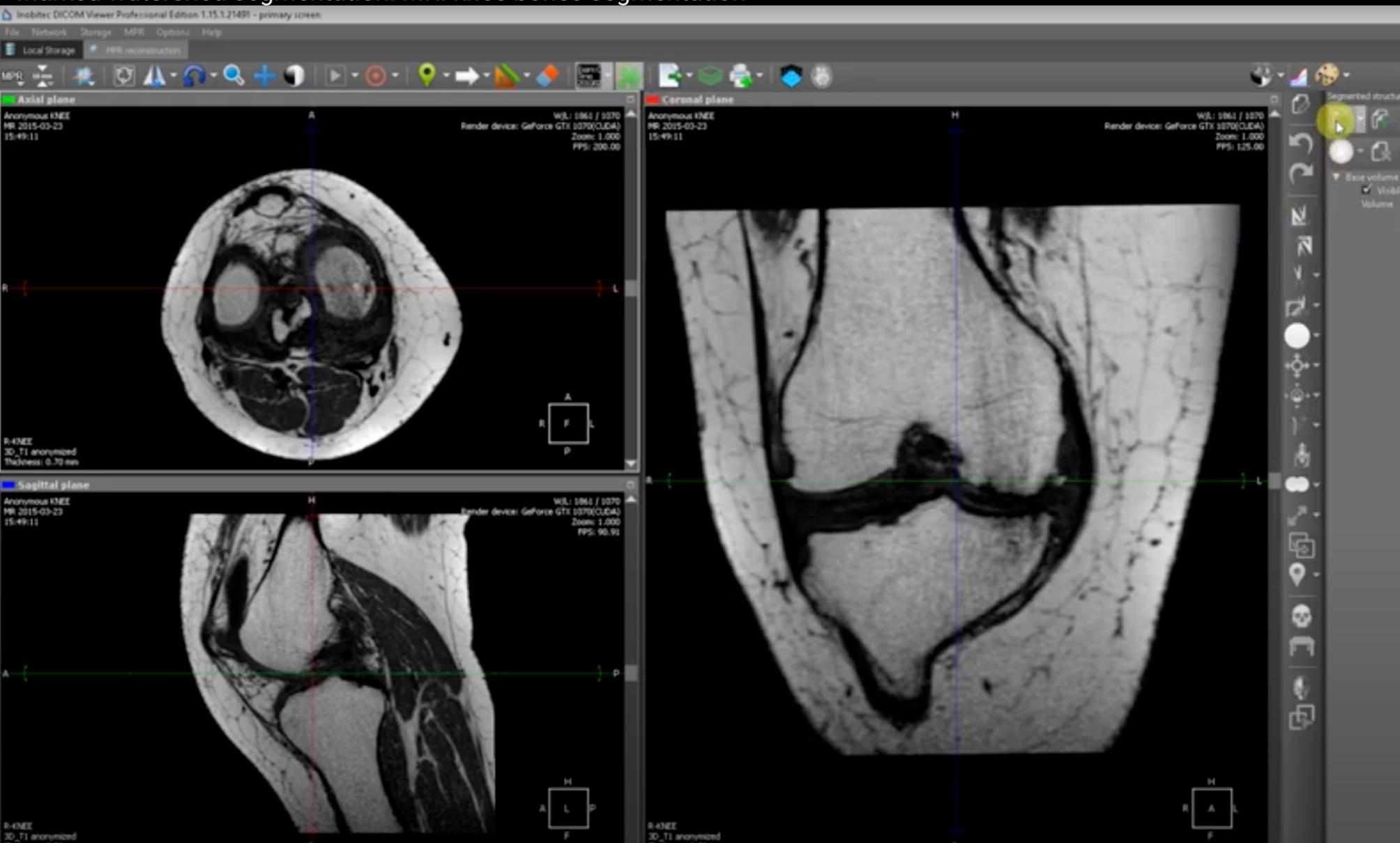
# Project

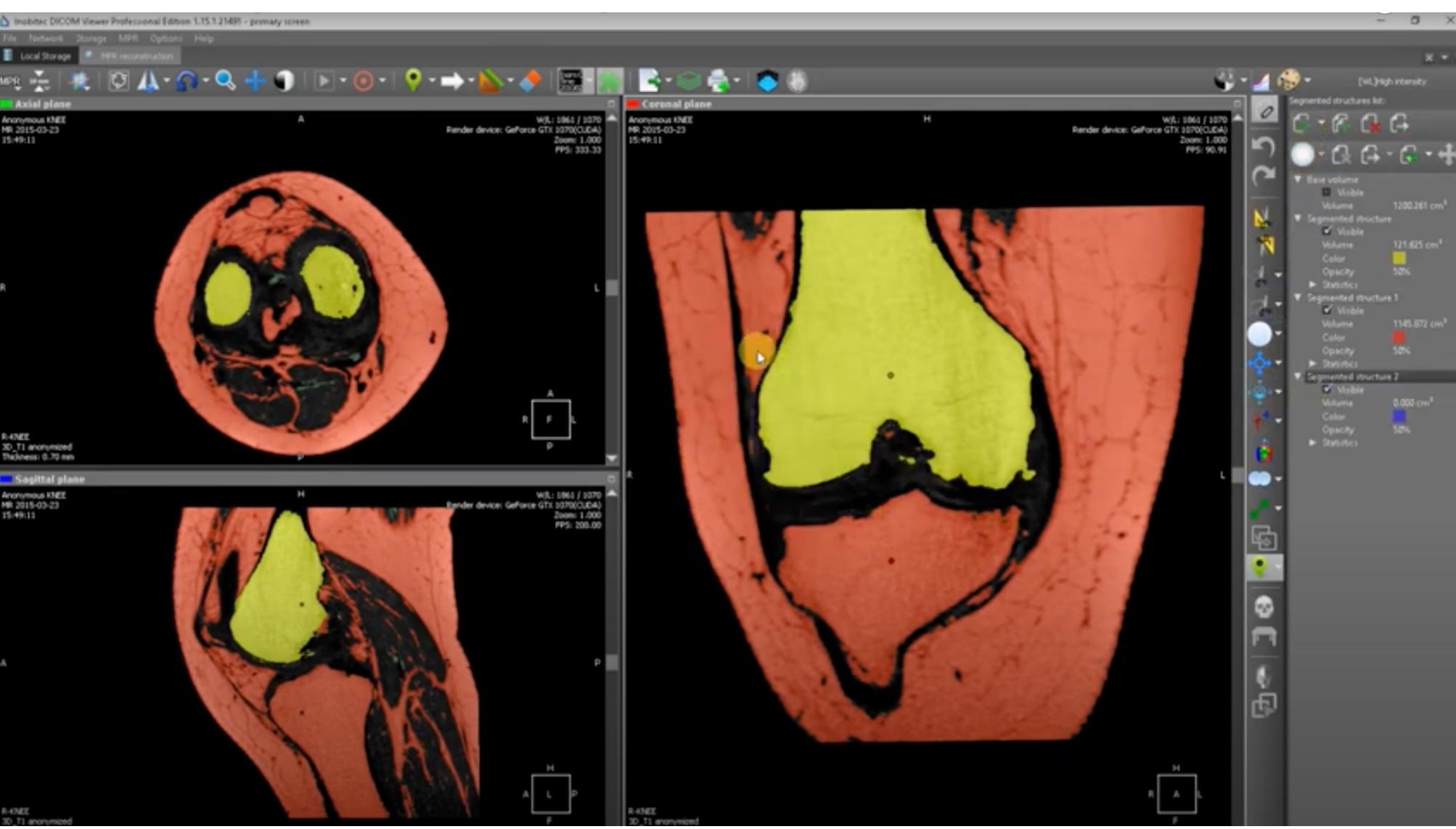
- Project 20% of the course
- Paper selection + Initial report ( 1 page) Submission: 5
- Code Execution + Results = 10%
- Paper Presentation 5%
- New Ideas 5% Bonus

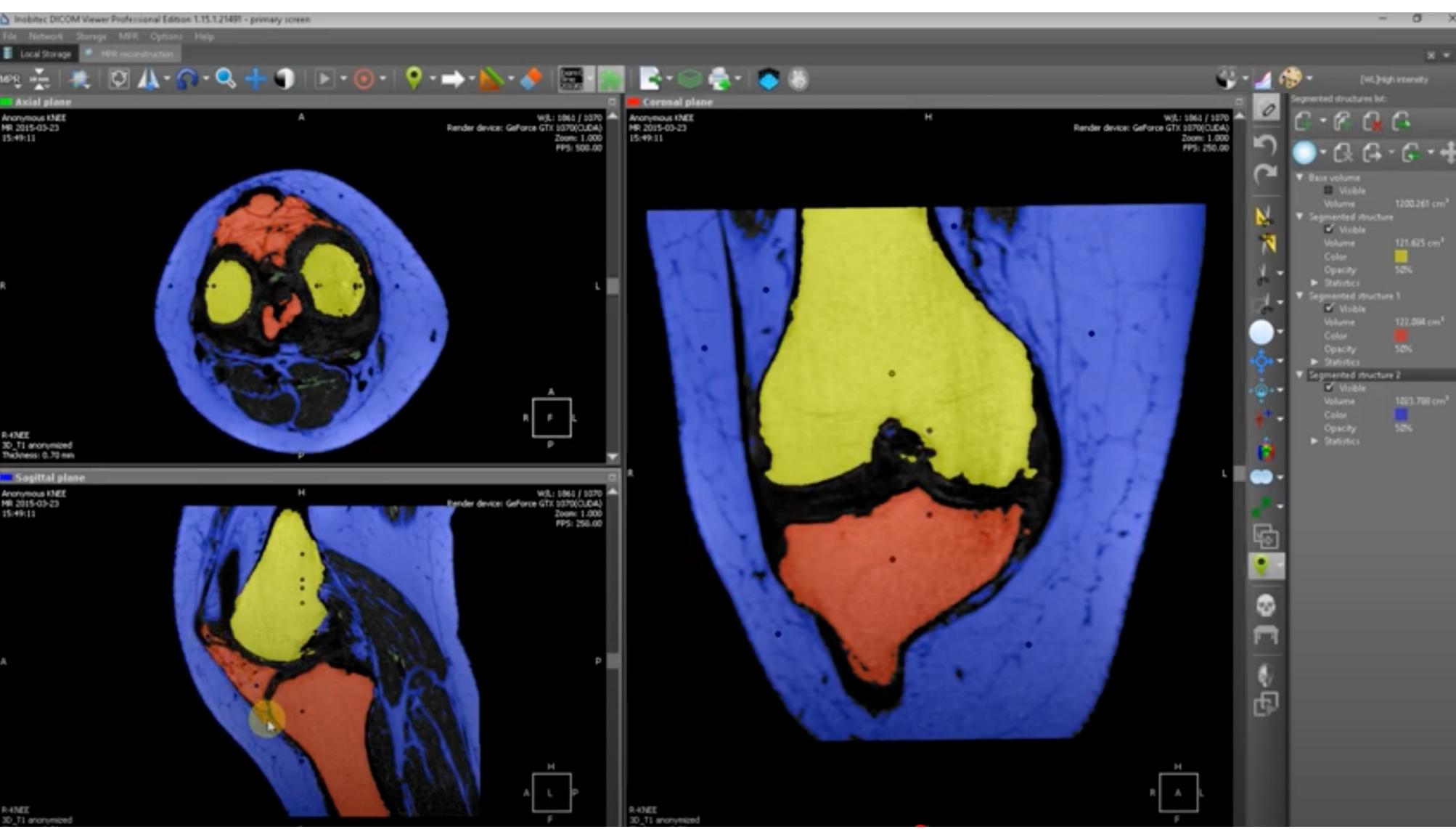
- How to select Research paper
- How to read Research paper

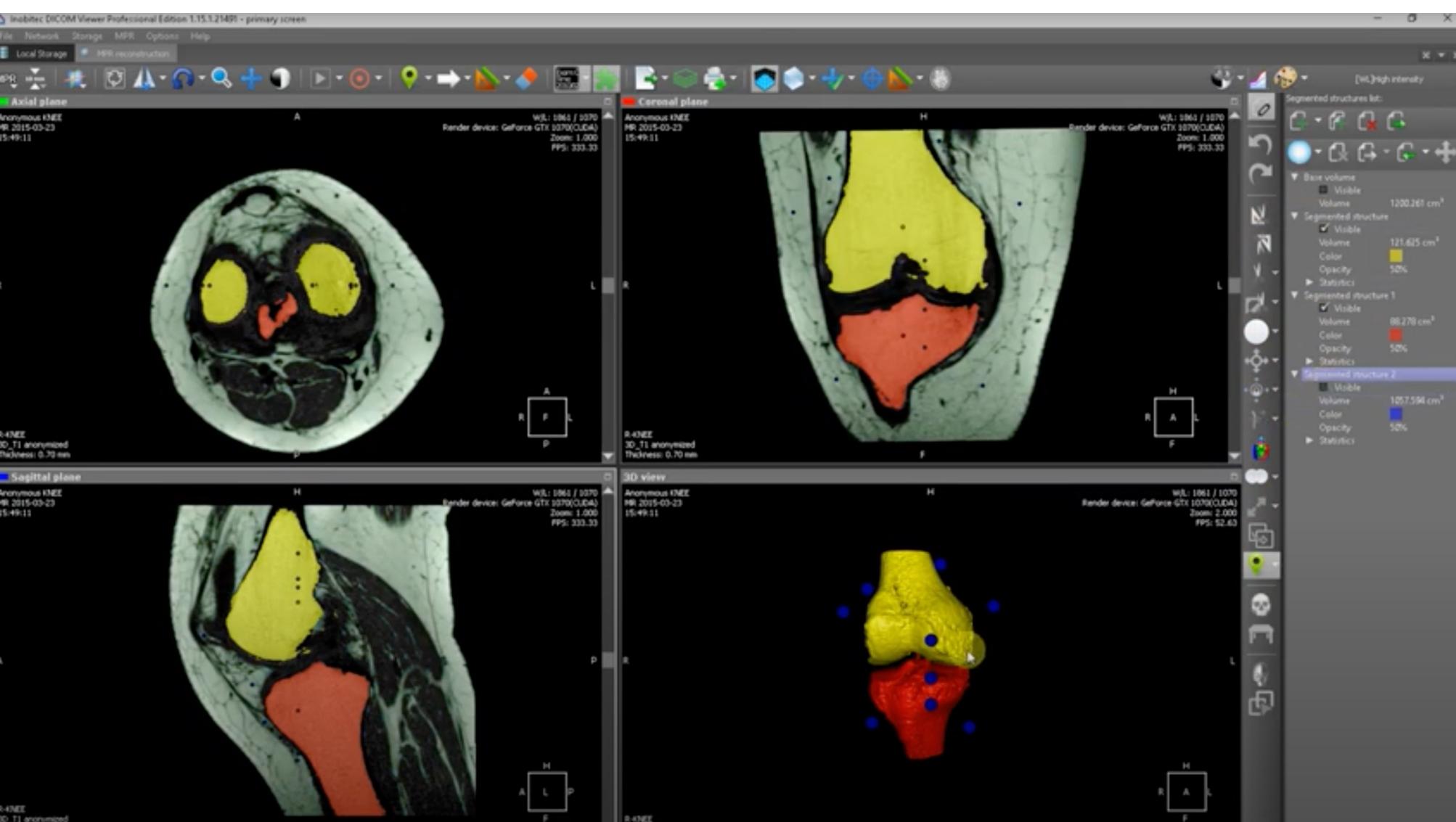
# Interactive Segmentation

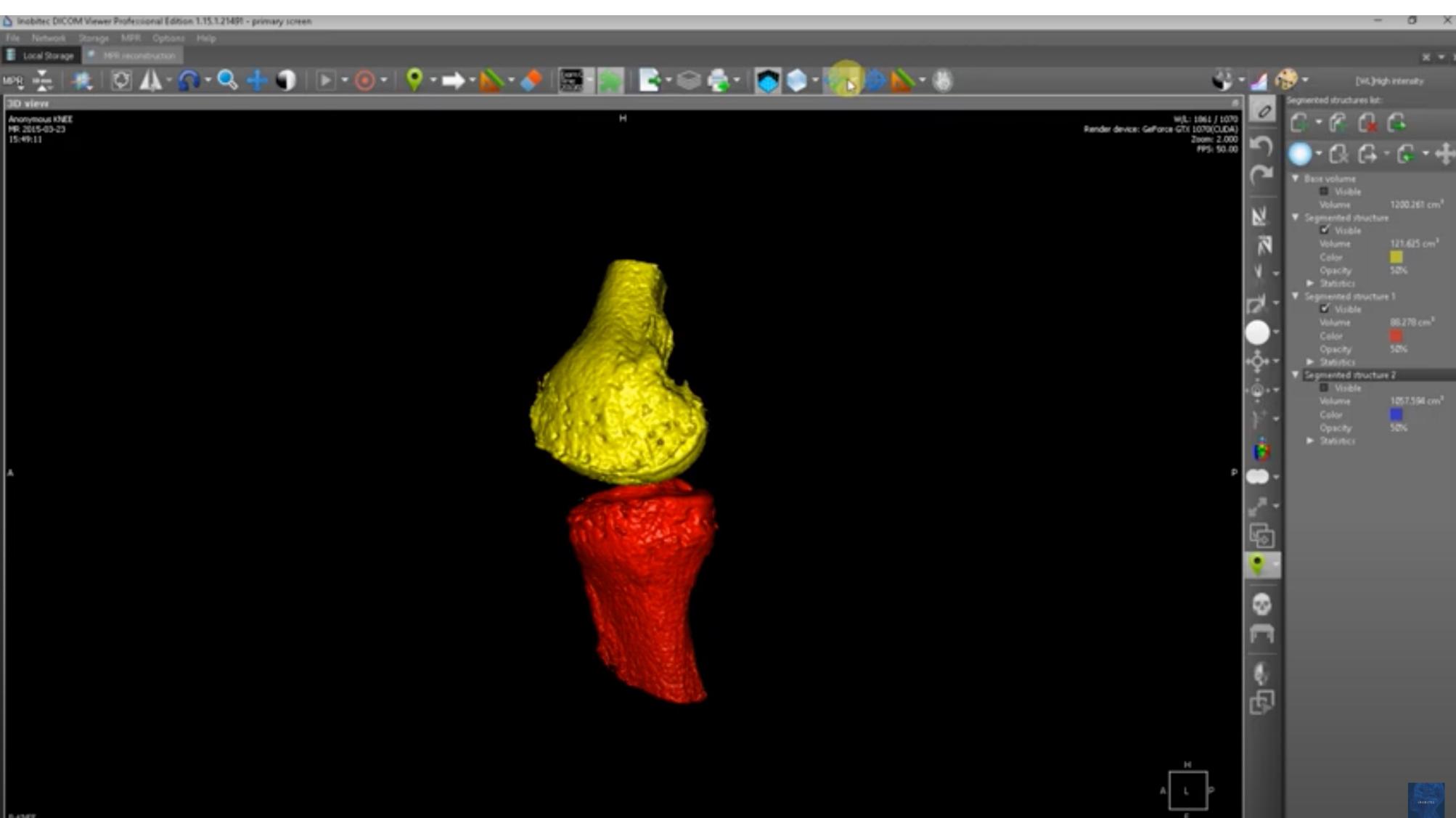
Marked watershed segmentation: MRI knee bones segmentation

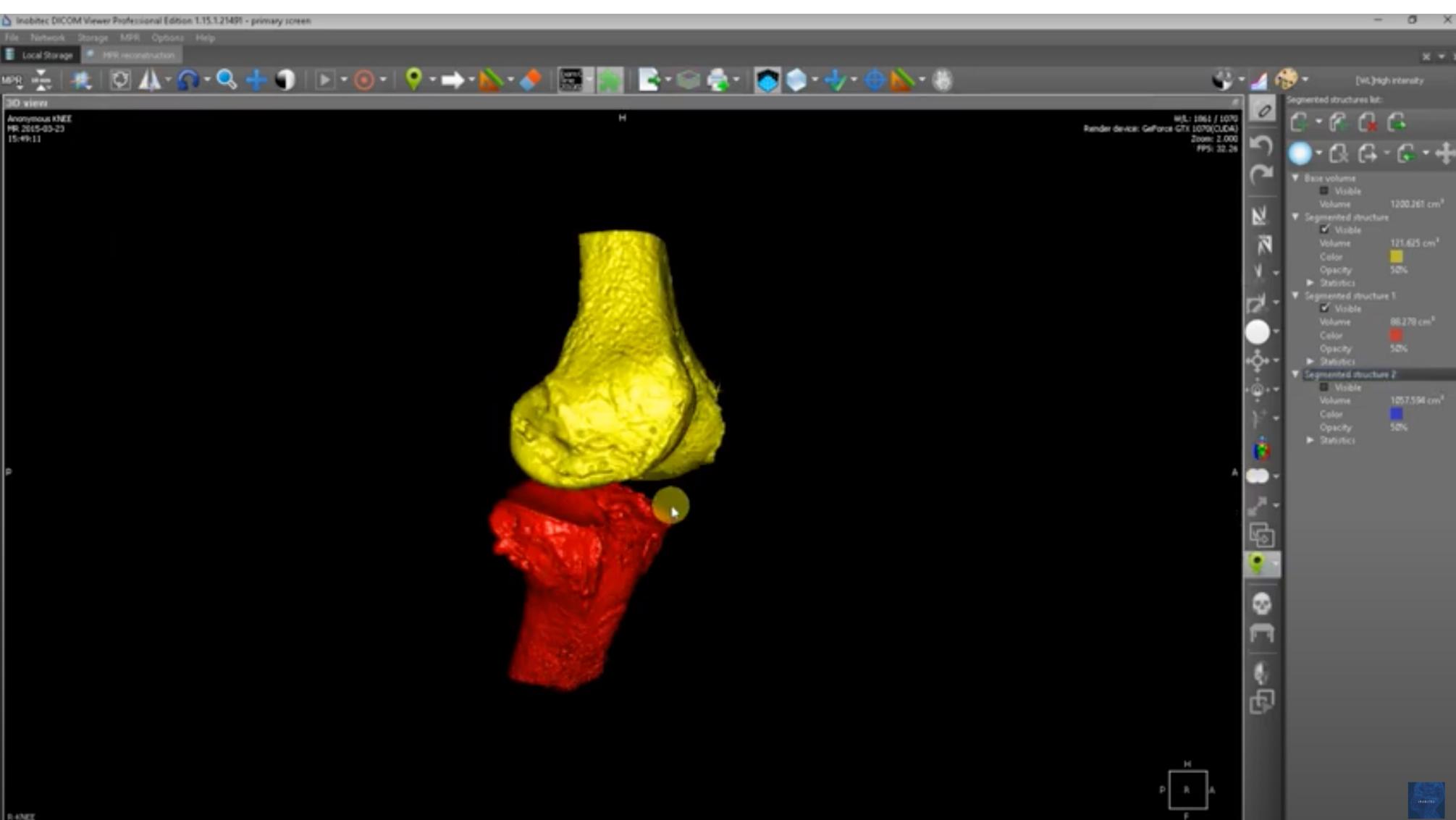


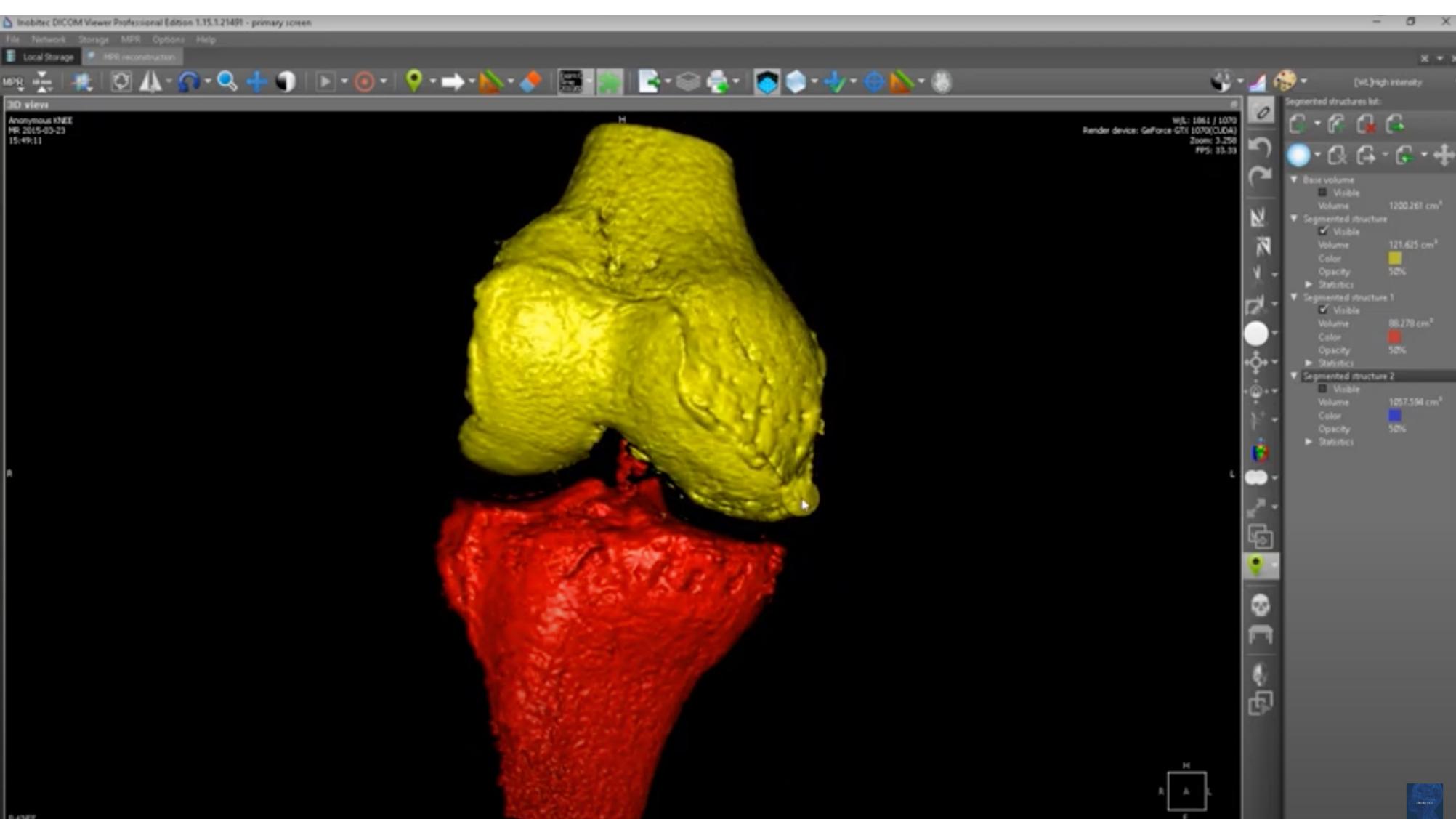


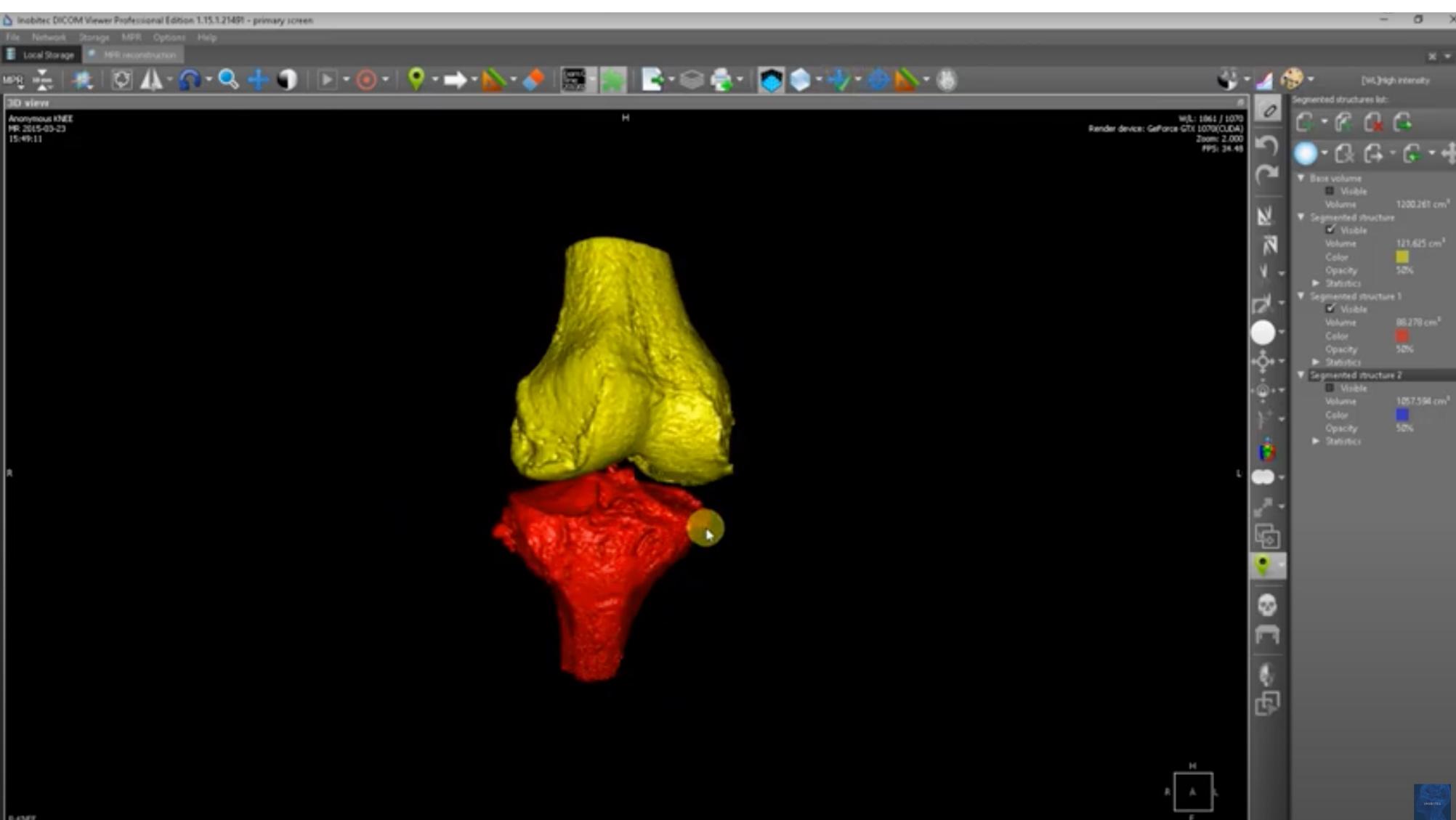


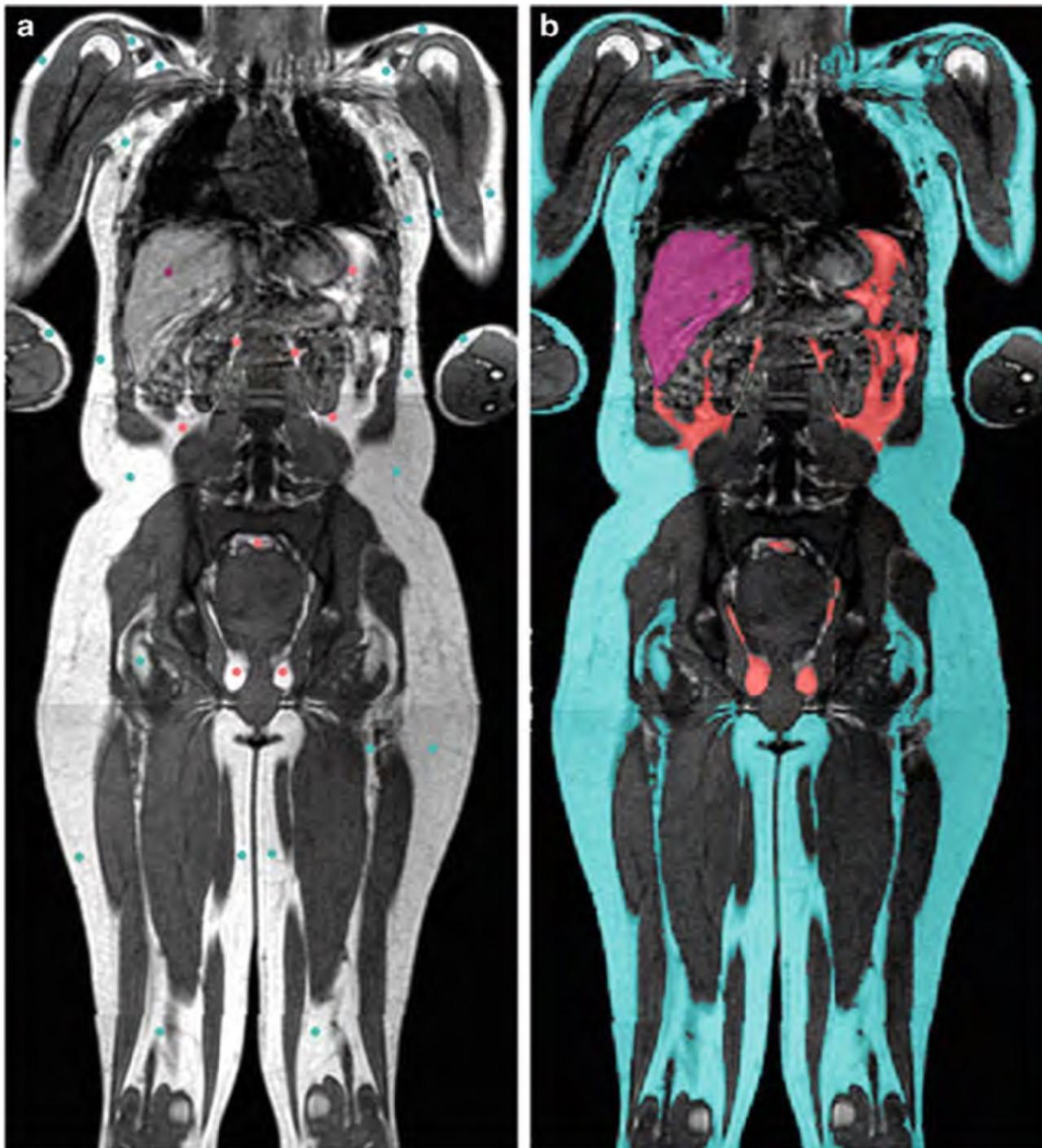












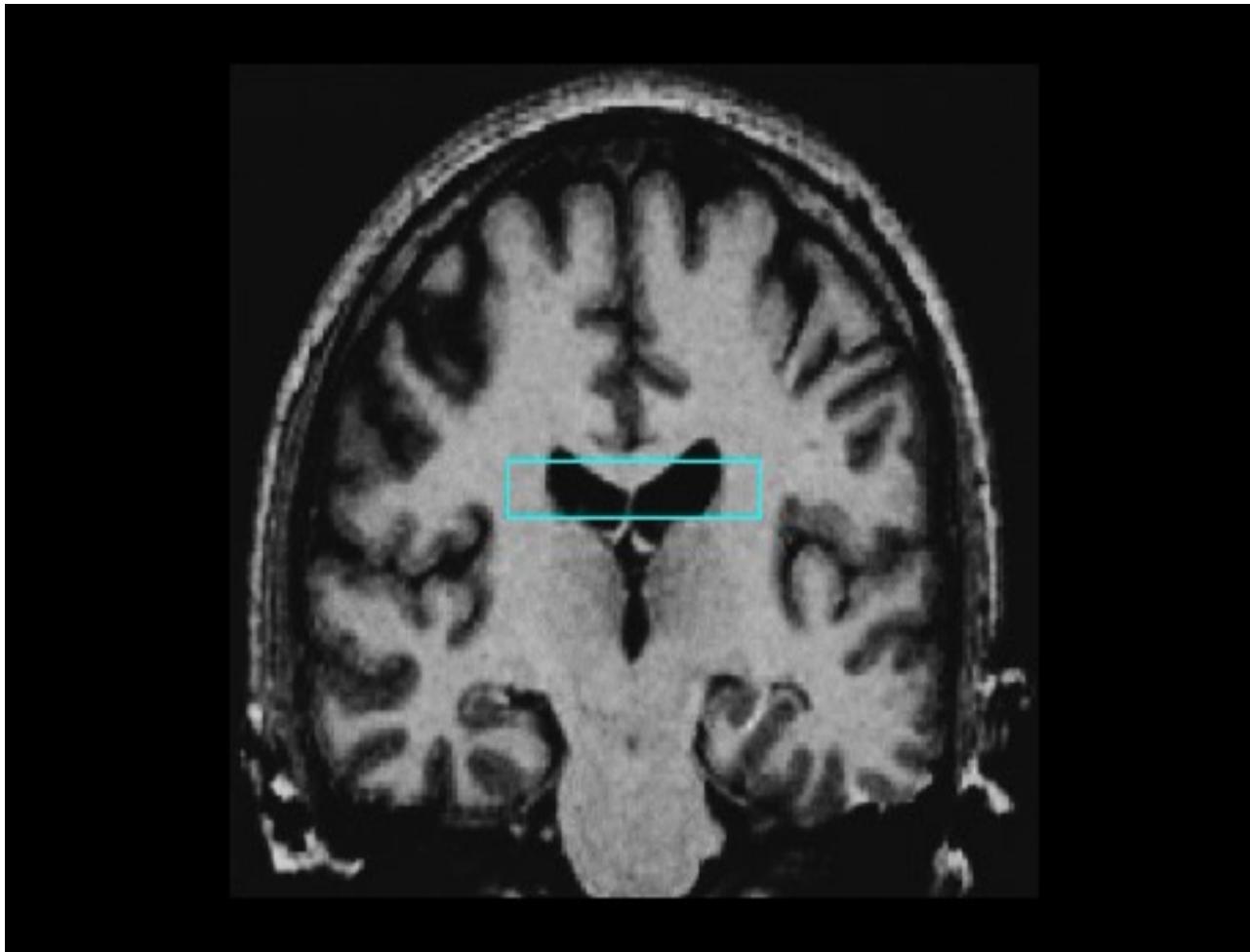
## Example: Fat Segmentation in MRI

T1 weighted MRI  
Red: visceral fat  
Purple: liver  
Blue: Subcutaneous fat

*Credit: Dougherty, G.,  
Medica Image Processing.*

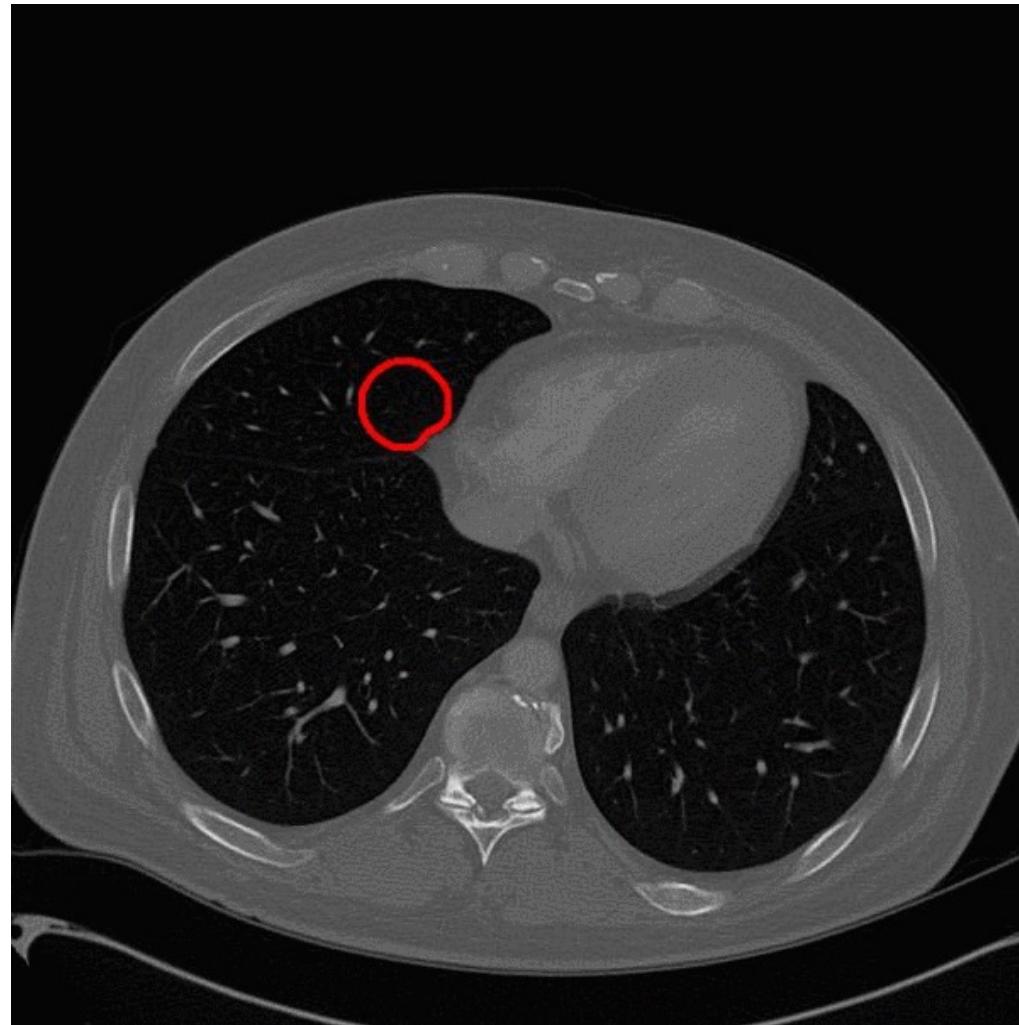
# Interactive Segmentation

## Active Contours



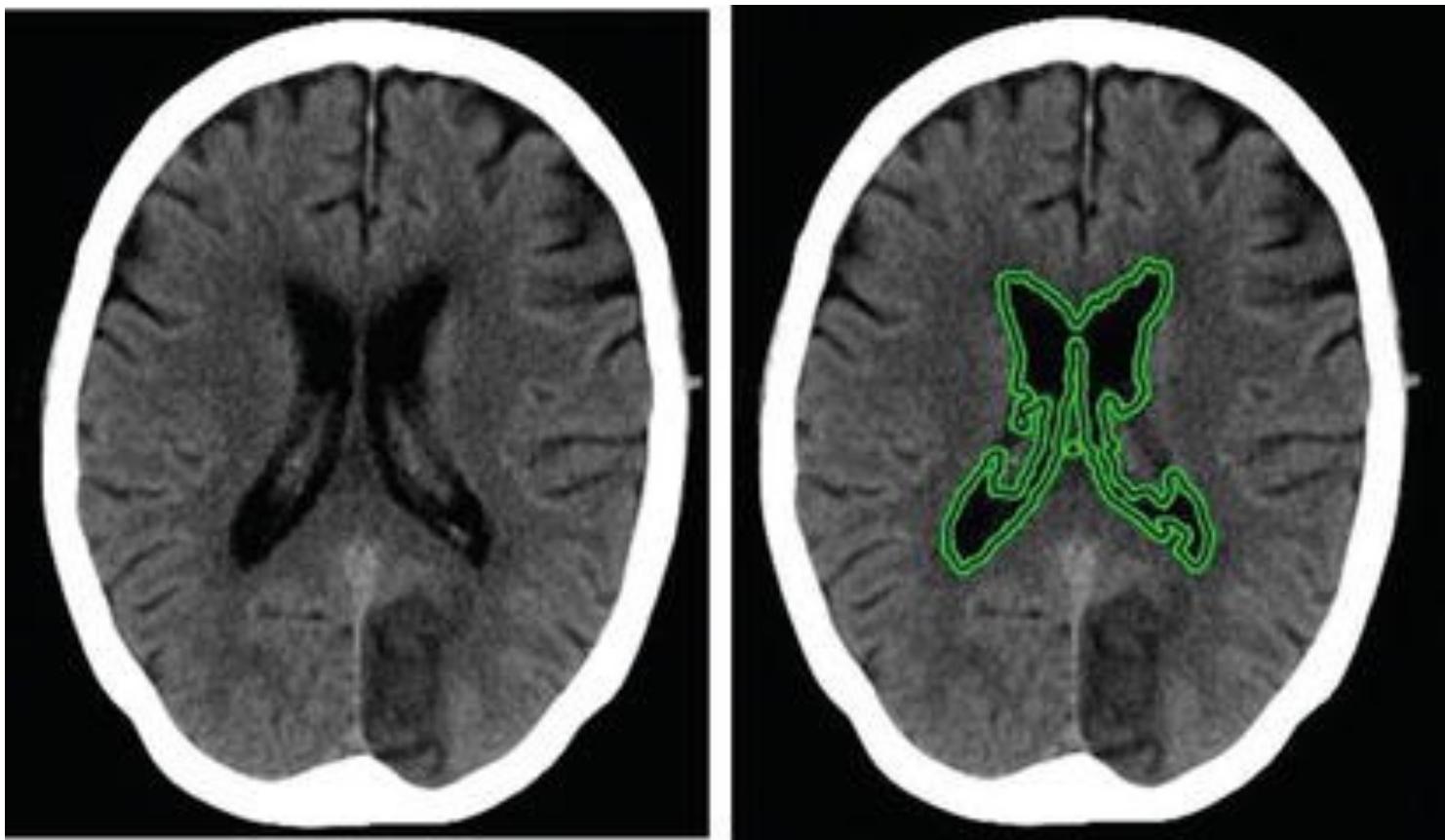
# Interactive Segmentation

## Active Contours



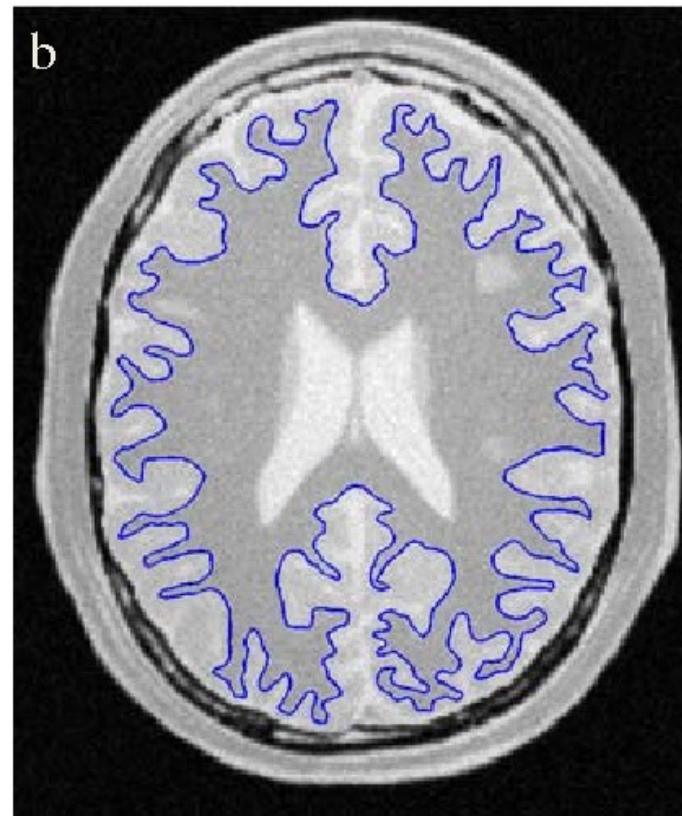
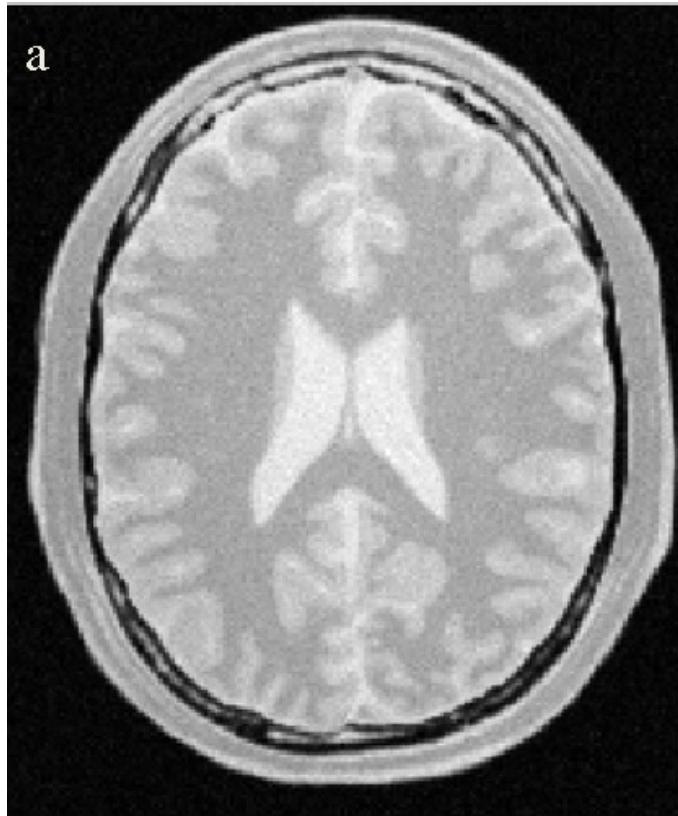
# Interactive Segmentation

## Active Contours



# Interactive Segmentation

## Active Contours



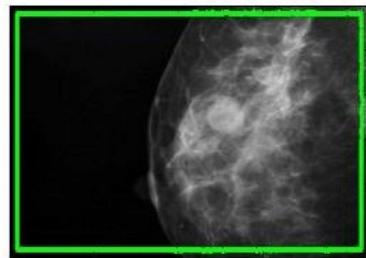
# Interactive Segmentation



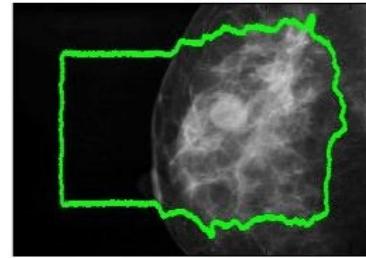
**Active Contours**

# Interactive Segmentation

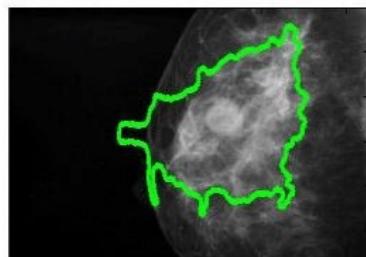
## Active Contours (Failure case)



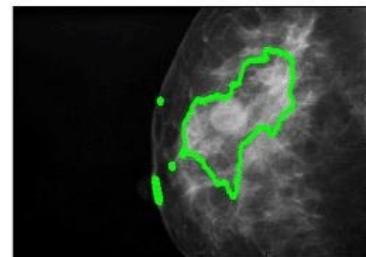
(a)



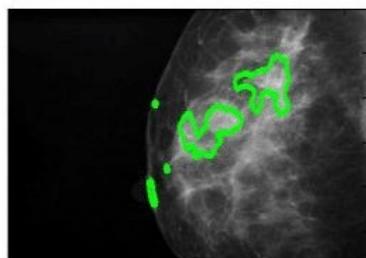
(b)



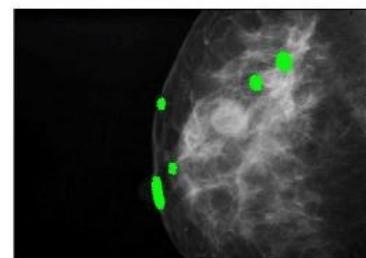
(c)



(d)



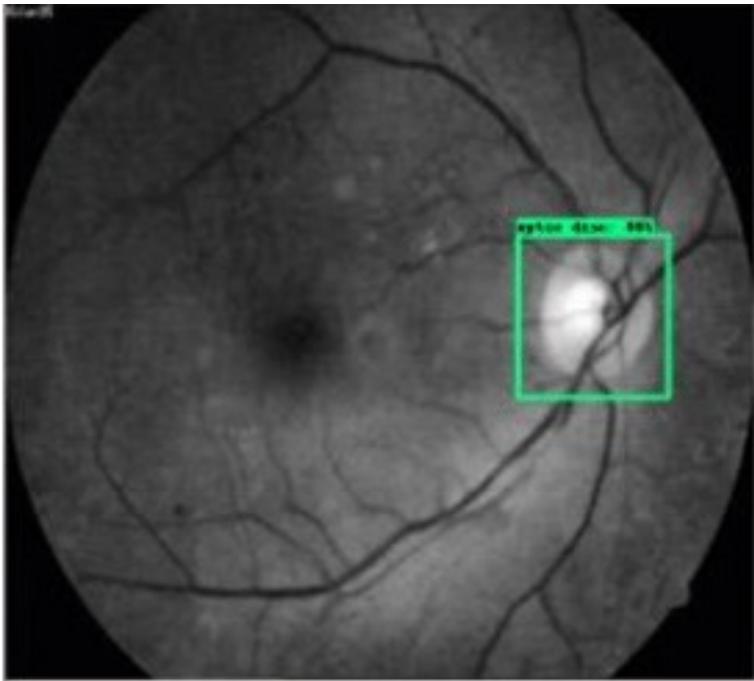
(e)



(f)

# Interactive Segmentation

## Grab Cut



**Grab-Cut** is an image [segmentation](#) method based on [graph cuts](#).

Starting with a user-specified [bounding box](#) around the object to be segmented, the algorithm estimates the colour distribution of the target object and that of the background using a [Gaussian mixture model](#). This is used to construct a [Markov random field](#) over the pixel labels, with an [energy function](#) that prefers connected regions having the same label, and running a graph cut based optimization to infer their values.

# References and Slide Credits

- Jayaram K. Udupa, MIPG of University of Pennsylvania, PA.
- P. Suetens, Fundamentals of Medical Imaging, Cambridge Univ. Press.
- N. Bryan, Intro. to the science of medical imaging, Cambridge Univ. Press.
- CAP 5415 Computer Vision (Fall 2016) Lecture Presentations