University of Burgundy

Masters in Computer Vision and Robotics

Medical Imaging Analysis Lab

Report for Post-Processing of Prostate MRI

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CONTENTS

1. Problem Statement:

Adenocarcinoma of the prostate appears in older men. About 85% of cases are diagnosed in men over 60 years. Prostate cancer is a common cancer who's the incidence and mortality are now steadily increasing (85,000 new cases per year in Europe) [1]. It is the second most common cancer after lung cancer and the third leading cause of cancer death in men (9% of all cancer deaths in men in Europe). The location of Prostate gland is shown in Fig. 1.

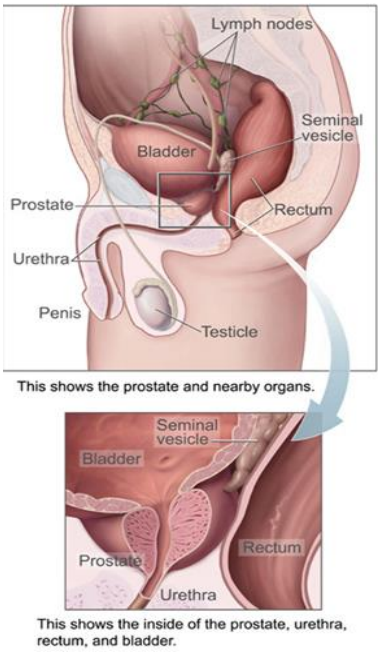
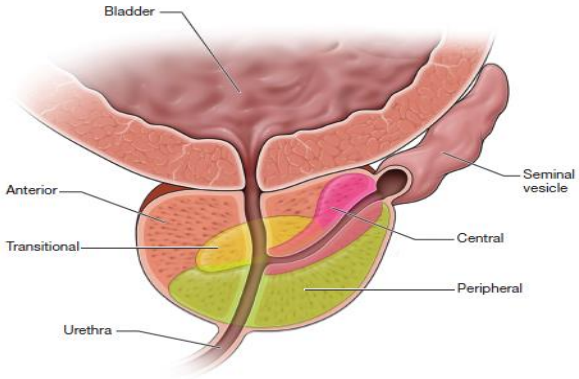


Figure 1: Location of Prostate Gland

Currently, there are four anatomically glandular areas within the prostate (as shown in Fig. 2):
- Peripheral zone (ZP)
- Central zone (ZC)
- Transition zone (ZT)
- Anterior Fibromuscular Tissue (AFT)



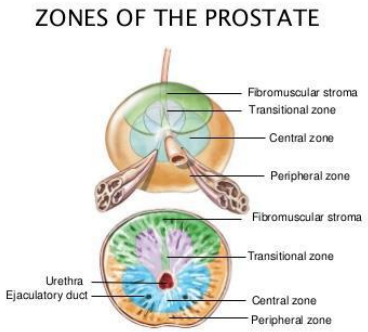


Figure 2&3: Anatomy of the prostate in transversal and sagittal plane

Adenocarcinoma arises in 75% of cases in the ZP, in 20% of cases in the ZT and in 5% of cases in the ZC.

2 Diagnostics:

High-resolution images are acquired in all planes of space using MRI which allows precise prostate anatomy visualization. MRI of prostate cancer benefits from technological advances that expand more indications. Now, we have tools to construct 3D models to represent iso-surfaces for volumetric study, annotate and diagnose the prostate cancer. MRI is a valuable tool to guide therapeutic management of prostate cancer through acquisition sequences [2] as follows:

• Anatomical imaging– 3D - T2 weighted imaging
• Diffusion imaging – ADC (Apparent Diffusion Coefficient)
• Perfusion imaging –DCE (Dynamic Contrast Enhancement)
(Observation from signal-intensity time curve)
• Spectroscopy

Information about DICOM Images:

DICOM is a standard for recording and transmitting information in medical imaging. It includes a file format definition and a communication protocol TCP/IP to communicate between systems. DICOM files exchange can be possible between two entities that are capable of receiving image and patient data in DICOM format.

A DICOM format file encapsulates an image and data object, data object consists of a number of attributes, including items such as Patient Name, Patient ID, Examination Date, Instance Number, Slice Location, etc., and also one special attribute containing the image pixel. A single DICOM object can have only one attribute containing pixel data, but the attribute may possess multiple "frames", allowing storage of cine loops or other multi-frame data. Another example is NM data, it is a multi-dimensional multi-frame image where 3D or 4D data can be encapsulated in a single DICOM object.

3.1 Building GUI

The GUI is designed using MATLAB as shown in Fig. 4 &5.

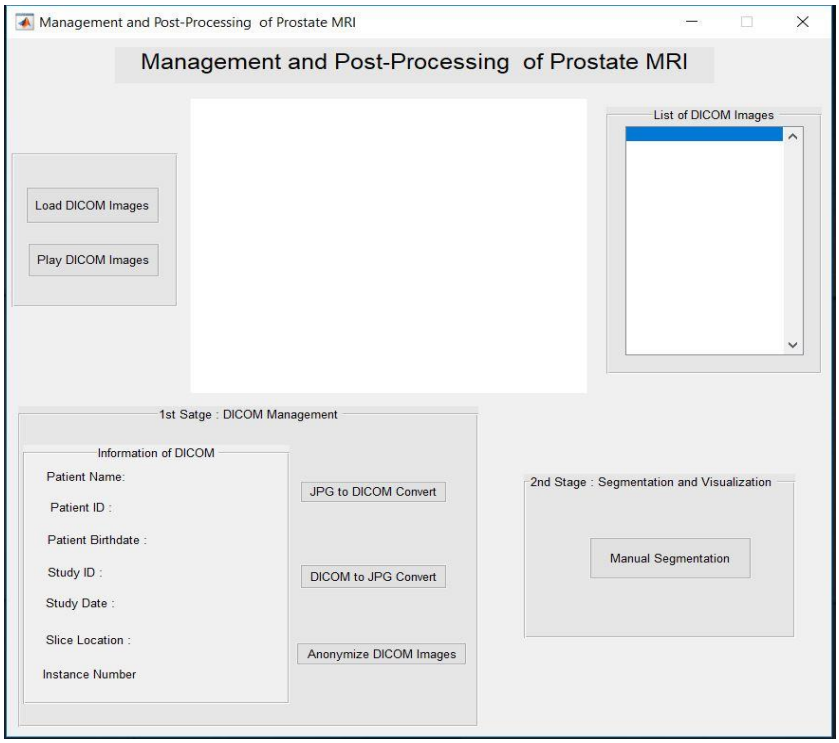


Figure 4. The Design of GUI

3.2 Stage-1 Description

Processing can be done in these steps:

1. Load DICOM Image
2. Anonymize DICOM Images.
   Convert DICOM images in JPG format.
   Convert JPG Images to DICOM format
3. Manual Segmentation
4. 3D Representation
5. Area and Volume Calculation

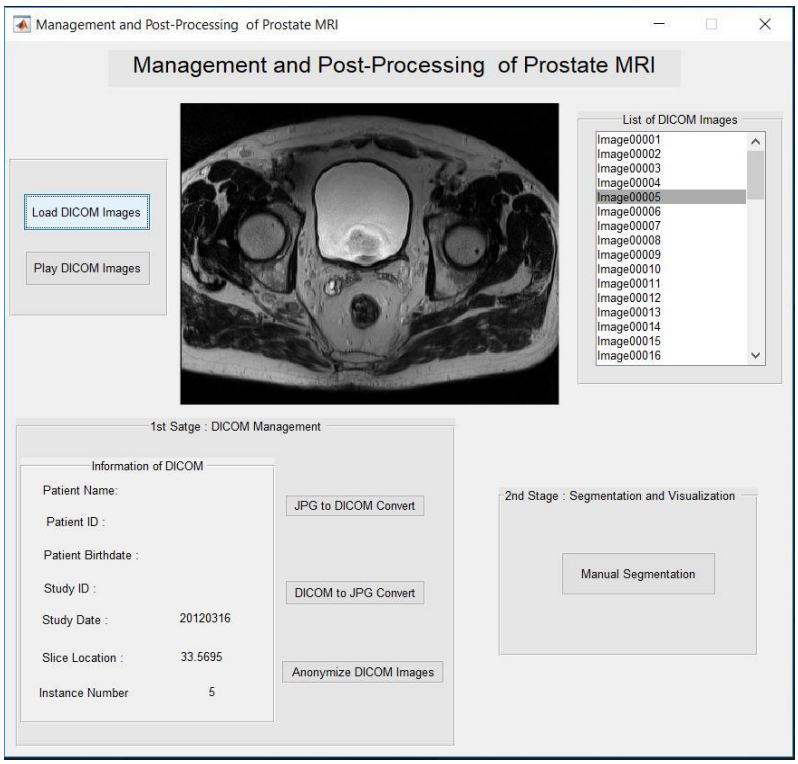


Figure 5: Complete GUI at first image

Loading Phase: All the DICOM images are loaded on click Load Button.

Format Conversion Phase: The "Anonymize Images" button anonymize the images as required and "Save Anonymize Images" button saves the images and data in DICOM format to 'Anonymized Images' folder in current working directory.

The "Convert to JPEG" button converts the DICOM images to JPEG and saves the metadata in 'Meta Data' folder. "Convert Jpeg to DICOM" button converts the Jpeg images to DICOM images and saves them in 'DICOM Images' folder.

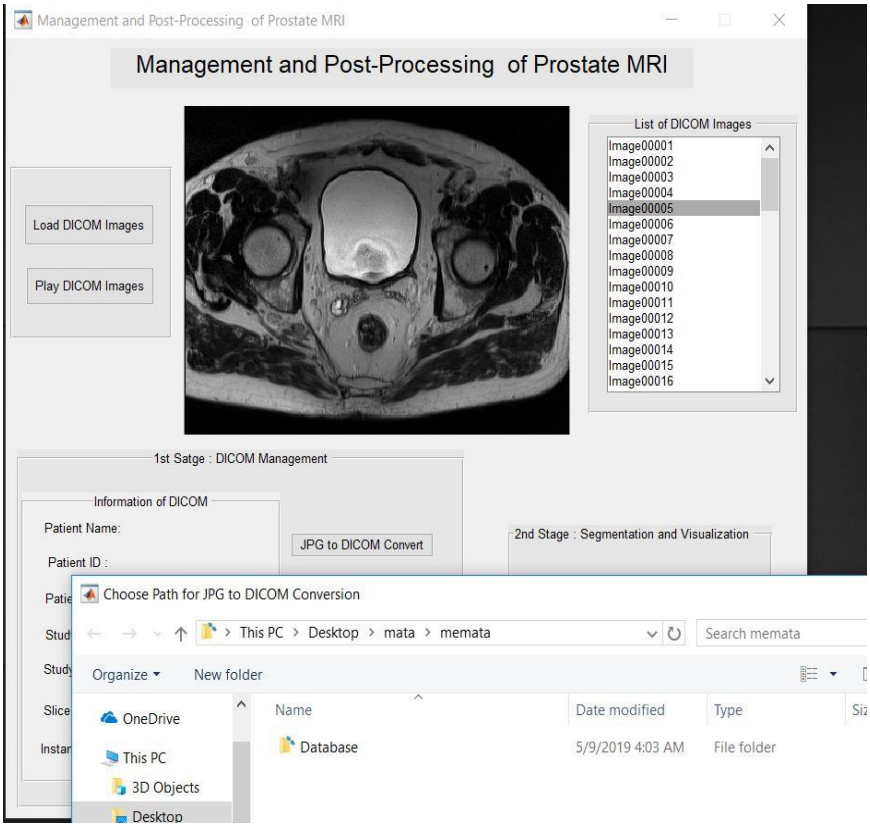


Figure 6: Convert to DICOM

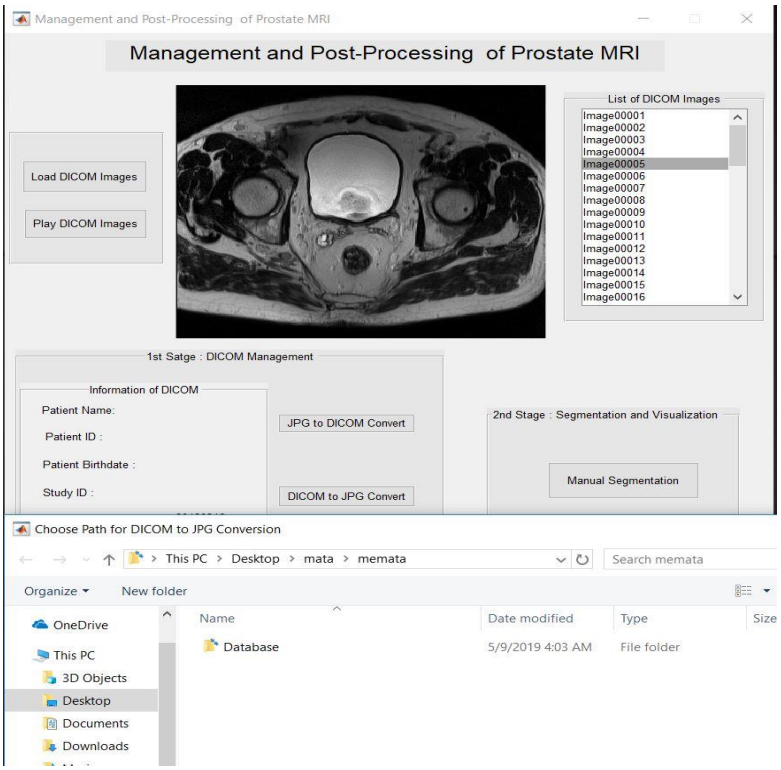


Figure 7: Convert to JPG

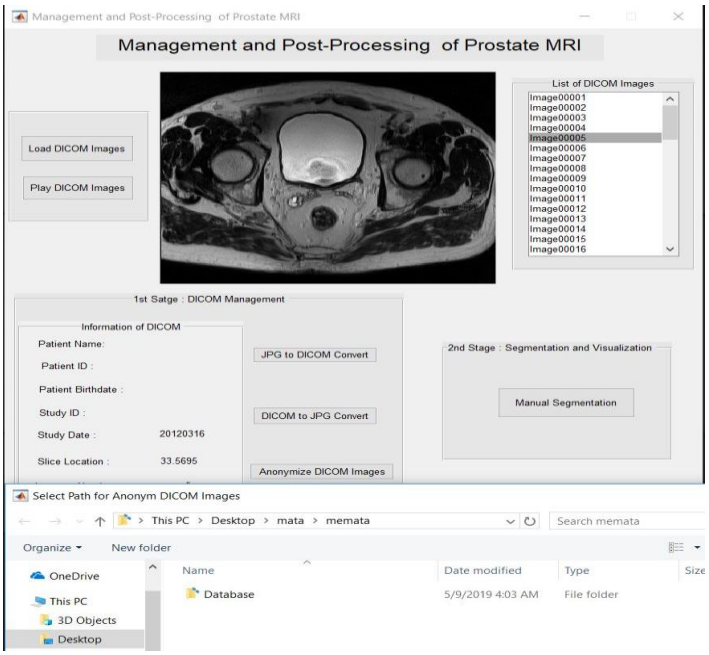


Figure 8: Convert Anonymous to DICOM Images

3.3 Stage-2 Description: Manual Segm. and 3D Representation

Segmentation Phase: Here in the ""Segmentation" panel , the four buttons with prostrate regions names Peripheral Zone, Central Zone, Transition Zone and Tumor Zone are used to manually segment the regions accordingly and the segmented region images will be displayed After selecting appropriate region double click on the region to represent it in 3D. We can also use ‘Snake’ semi-automatic algorithms for the robust segmentation.

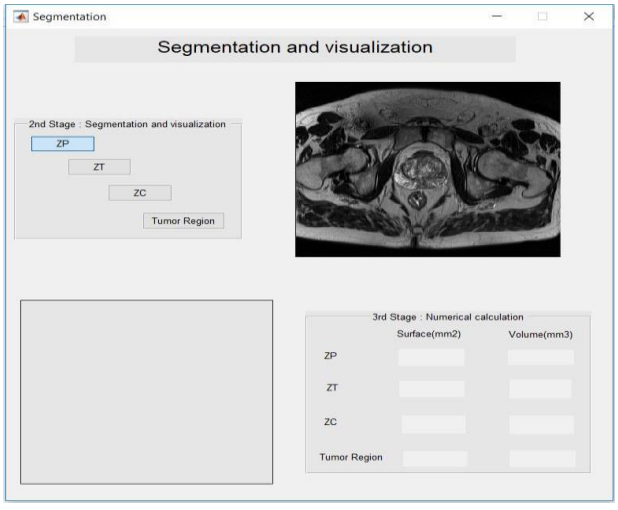


Figure 9: Segmentation Panel

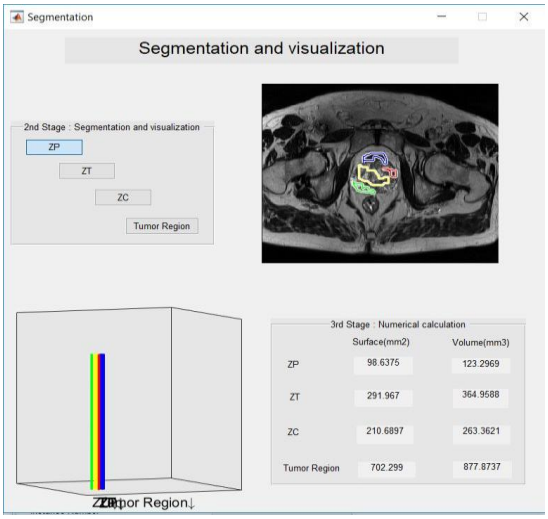


Figure 10: 3D Representation after Segmentation

3D Representation Phase: On button click “3D view” takes images of all slices of a region of gland and constructs its 3D view. Also see the 3D represented image in previous page.

Other Appropriate Views of the Required Regions:

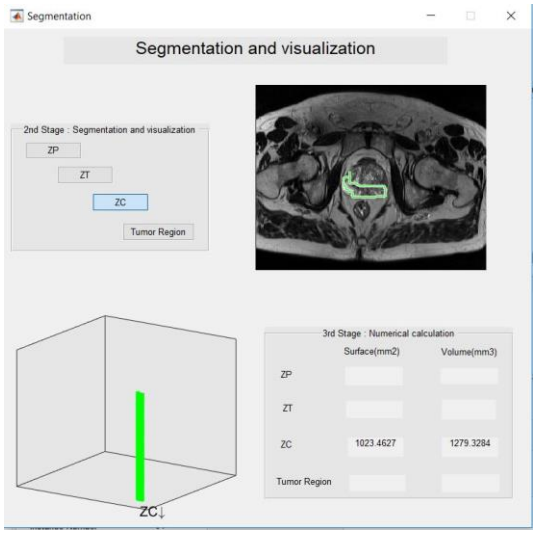


Figure 11: 3D Representation of Zc region

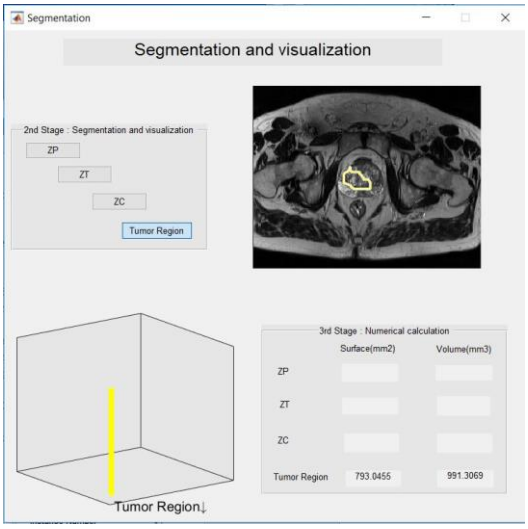


Figure 12: 3D Representation of Tumor region

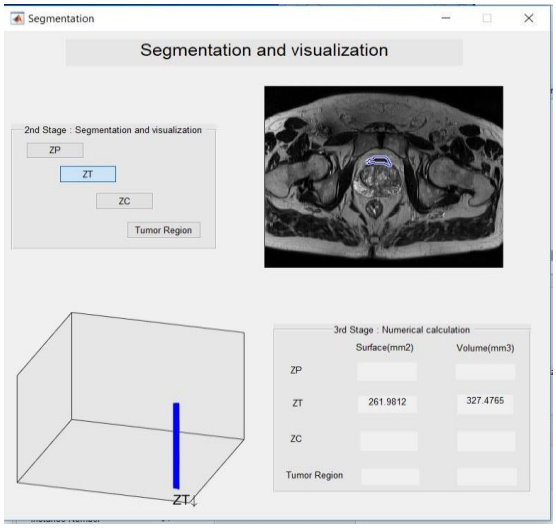


Figure 13: 3D Representation of Zt region

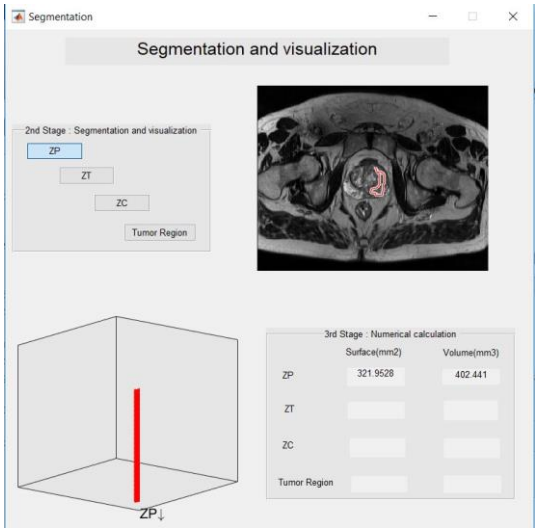


Figure 14: 3D Representation of Zp region

3.4 Calculations

"Area and Volume" panel contains button to calculate area and volume of selected four regions of the gland.

Using MATLAB inbuilt properties, *'regionpros'* command to define region properties object. By using this object we call *'area'* function to get total number of pixels in the region.

In order to calculate the surface and volume we should use the DICOM information.

• For each region calculate the surface (Surface area = number of pixels x spatial resolution)

• Calculate the volume for each region (Volume of the region = Surface area x slice thickness)

Note:

- Before converting the DICOM data into JPG format we have to save the metadata of each image in a '.mat' file because while converting the images to JPG format, we don't consider the metadata.

- Also, we convert JPG images into DICOM format but also concatenate the metadata of each DICOM image with it.

4.1 Results:

We obtained the results to be:

1. Surface Area of the Tumor region = 793 sq.mm
2. Volume of the Tumor region = 991.3 cc

4.2 Conclusion

We have performed the post processing of MRI images of prostate gland by We have learnt how to access the metadata and conversion of medical image formats and anonymizing the data, manual segmentation of regions of prostate gland and 3D Representations (iso-surfaces) by reconstruction and also calculated the area and volume of the segmented regions.

5. References

[1] Website http://www.cancerresearchuk.org
[2] Lecture slides of Dr. Mata
[3] Dicom Wikipedia
[4] Mathworks Central
[5] Prostate Diagrams source Wikipedia