Medical Imaging

Lab 1 Report: Image Modalities

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1 Introduction

During this lab sessions, we started to be familiar with some modalities of the medical images, e.g. MRI, X-ray and Ultrasound, by inspecting their DICOM files using Matlab program. DICOM is, in fact, a standard for handling, storing, printing, and transmitting information in medical imaging.

2 Image information

In order to deal with DICOM files in Matlab, there are two handy functions: dicomread and dicominfo. The dimensionality of the read images are as follow:

Name of image or details	Pixel Spacing	Size
MAMMOGRAPHY image	[0.07 0.07]	3328*4096=13631488=13.63 MP
MRI image	[0.3125 0.3125]	512*512=262144=0.62 MP
Ultrasound image	Not available (not constant)	564*452=254928=0.254 MP

Concerning the patient information, e.g. Name, Birthdate, Other Name, Ethnic Group, and age in the previous three mentioned images, they are stored in the DICOM as encrypted data fields. For example, FamilyName: '8IHBhLdpWqt5OwI', PatientBirthDate: 00010101, PatientAge: 000Y, and so on.

The following figure shows the histogram, which is calculated in Matlab program, of the MRI volume provided with this lab assignment.

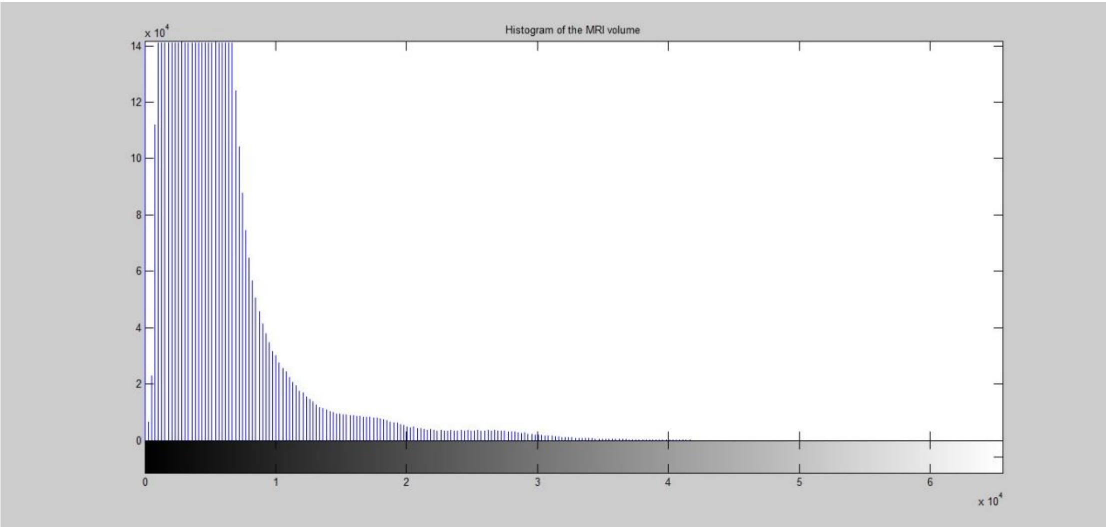

Figure 1: Histogram of the MRI image

It is evident from the figure that the range of the pixel intensities varies from 0 to 65535, even though pixels with this high value are very few. The provided MRI volume contains 22 different slices. Figures 2 to 4 show two central slices in axial, coronal, and sagital orientation.

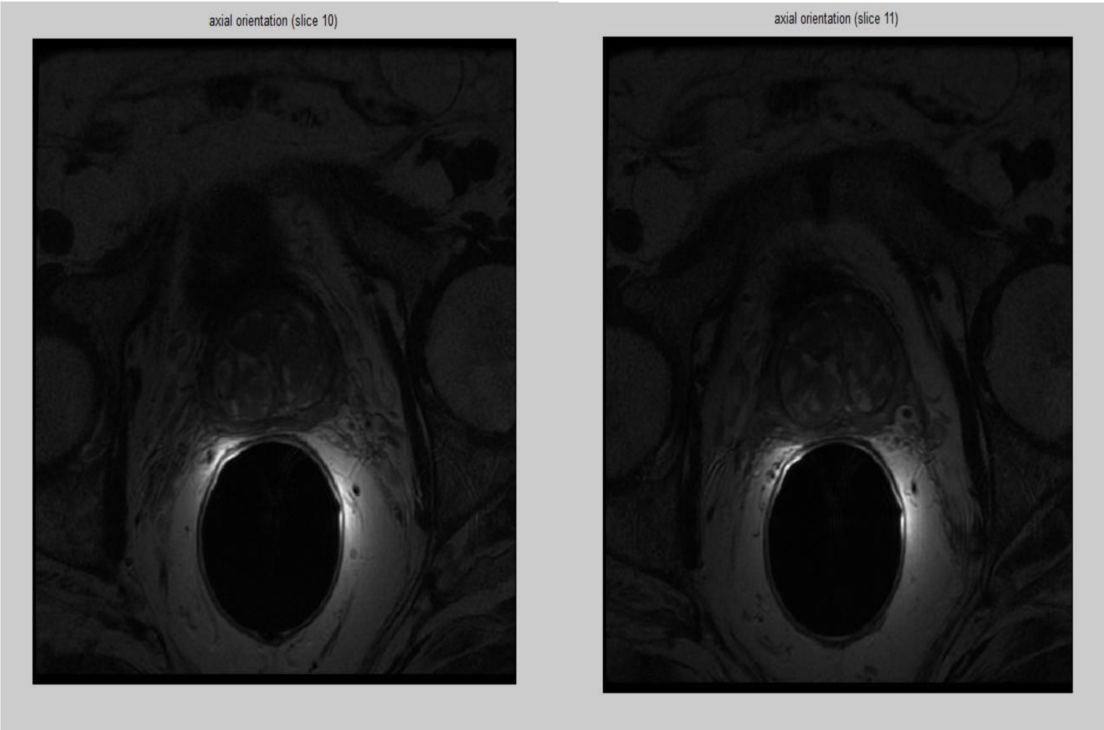

Figure 2: Tow central axial slices (10 & 11) of the MRI volume

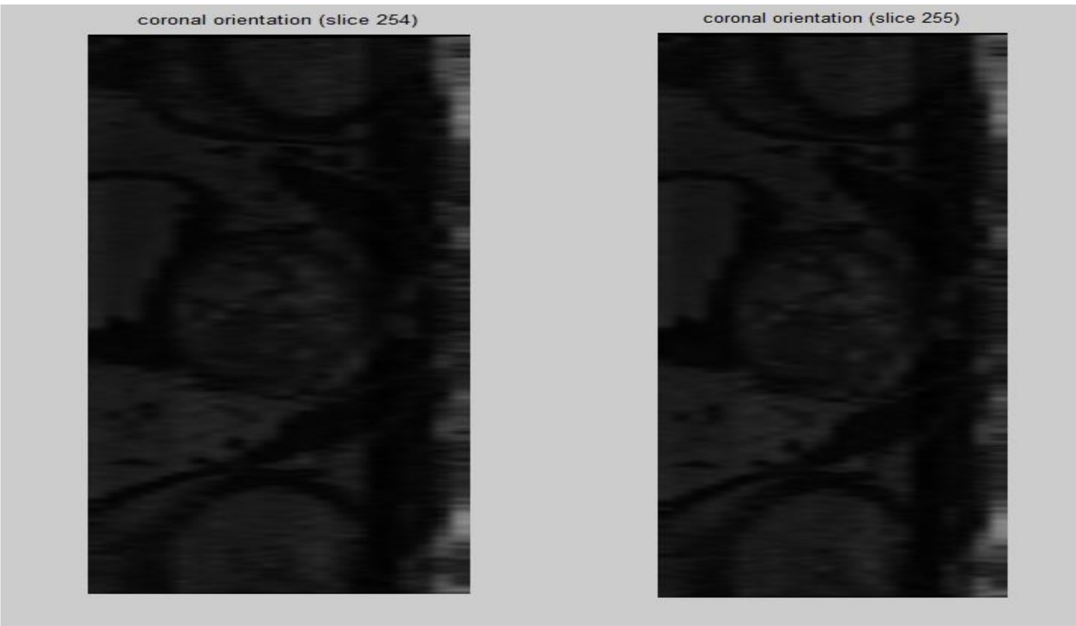

Figure 3: Tow central coronal slices (254 & 255) of the MRI volume

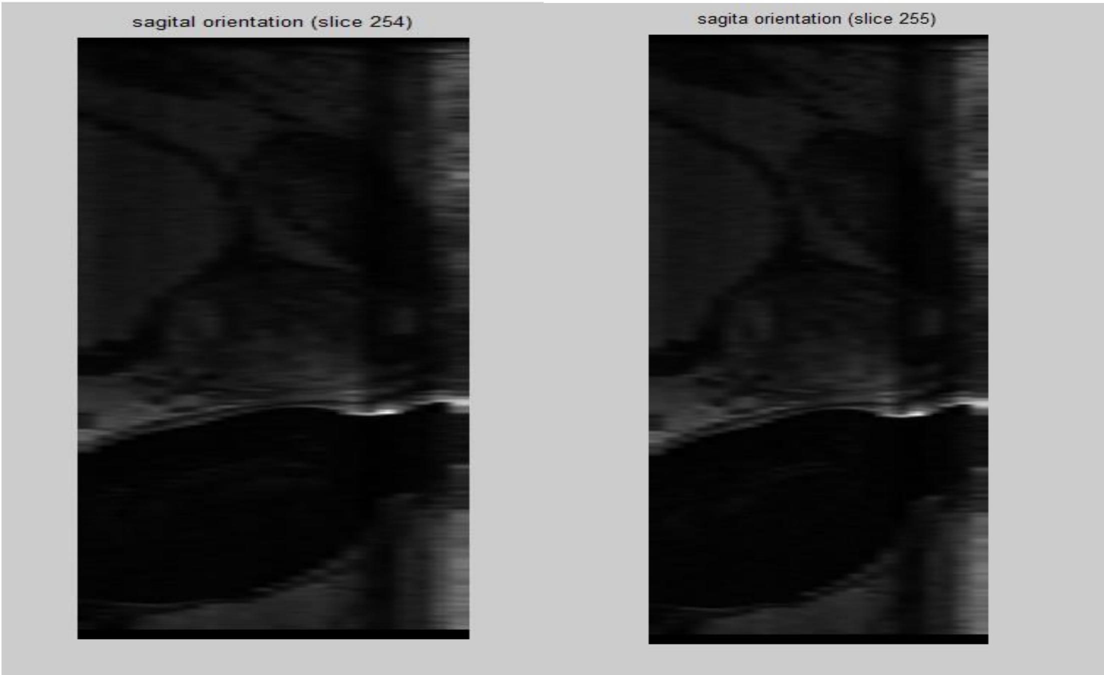

Figure 4: Tow central sagital slices (254 & 255) of the MRI volume

The next figure demonstrates two Mammogram images. One is called "raw" and the other is "presentation". As it is shown, the main difference is the more tiny white detailed parts inside the breast in the presentation image which makes it possible for doctors to diagnose it better.

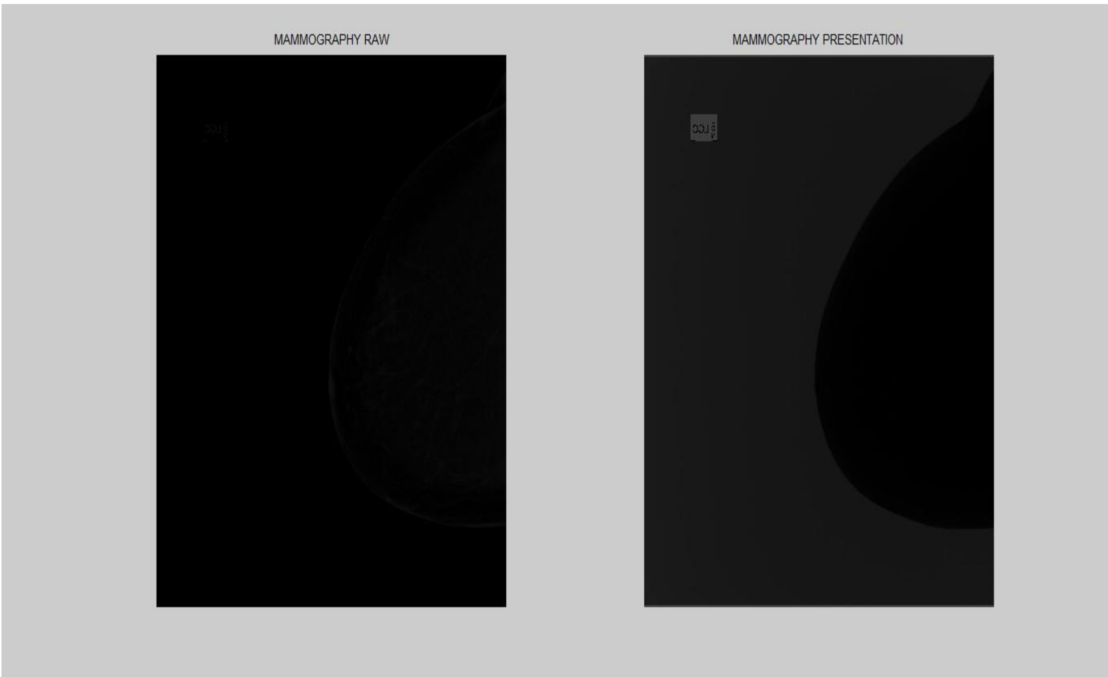

Figure 5: "Raw" and "Presentation" Mammogram images

3 Image transformation

The raw image in figure 5 shows a black area which represents the breast and a plain background. In order to obtain a valid image for diagnosis by radiologists, the representation image, there should be a number of processing steps to be taken:

1- First, since the background of this image is brighter than the entire breast, a good initial step is to give the background pixels zero value by setting all the pixels higher than a threshold to zero. A possible value for this threshold is around 5000 because all the breast's pixels have smaller values. The aim of this step is to ensure that the next processing steps will not affect the background in terms of multiplication.
2- The processed image has uint16 data type which means the maximum pixel value is 65535. This suggests that a gamma transformation with an exponent that is smaller than one is important. This is, in fact, necessary because it multiplies darker pixels of the breast by a higher factor than the brighter pixels which in its turn reveals more details in the breast.
3- To enhance the contrast in the image, unsharp masking was performed.
4- Adaptive histogram equalization was also applied so that image contrast was improved more.
5- Applying colors inversion was helpful to distinguish between the different tiny parts inside breast better.
6- Finally, a smoothing step was achieved to reduce the noise accumulating from the previous steps. Figure 6 shows the mammogram image processing evolution procedure.

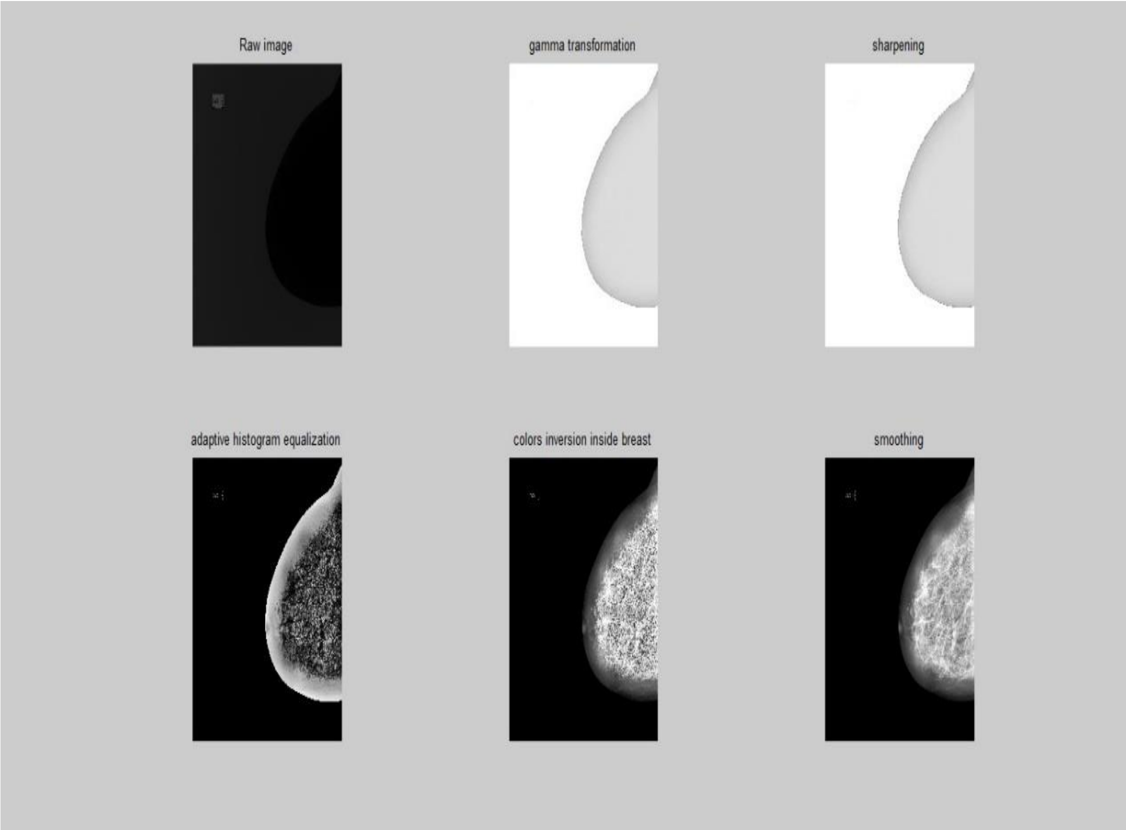

Figure 6: Evolution steps for mammogram image transformation