

Lab 1 - Image Modalities: Ultrasound, MRI and X-ray

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I. INTRODUCTION

In this lab, we know about how to open DICOM images and check the information of different modalities. Also, we use different transforms to acquire a high contrast raw mammography image. In the following section, we will answer the questions in the handout and then discuss the transformation details.

II. IMAGE INFORMATION

Questions answer:

A. Dimensionality, number of pixels and pixel size of each modality

1) X-ray images (Raw and Presentation)

- The dimensionality of is 4096×3328 . Get from the `info.Width` and `info.Height`
- The number of pixel is: 13631488
- The pixel size is: 0.07 in x direction, 0.07 in y direction. Get from `info.PixelSpacing`

2) Ultrasound image

- The dimensionality of is 452×564
- The number of pixel is: 254928
- There is not pixel size information for ultrasound image.

3) MRI

- The dimensionality of is $512 \times 512 \times 22$
- The number of pixel is: 5767168
- The pixel size is: 0.3125 in x direction, 0.3125 in y direction, 3.5 in z direction. The z dimension pixel size is acquired from `info.SpacingBetweenSlices`

B. Verify the files are anonymised

In order to verify the files are anonymised, `info.PatientName.FamilyName` will be visited. The list of the name of different modality is as follow:

- 1) The patient name of X-ray (Raw and Presentation) image is: 8IHBhLdpWqt5OwI
- 2) The patient name of ultrasound image is: 002
- 3) The patient name of MRI image is: 002

As we can see in the above, all the files are anonymised.

C. Visualize the histogram of the MRI volume

The histogram is shown in the Fig. 1:

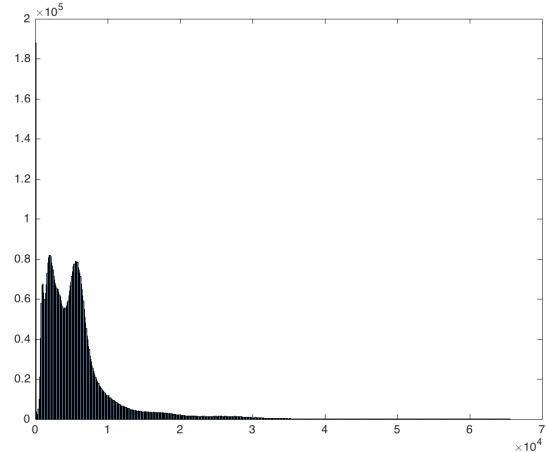


Fig. 1. Histogram of MRI volume

D. Visualize axial, coronal and sagittal view of MRI volume

In order to get the images of the three views, it should be noted that the spacing between two slices is almost 10 times larger than the pixel spacing. We need to resize the sagittal view and coronal view based on the ratio.

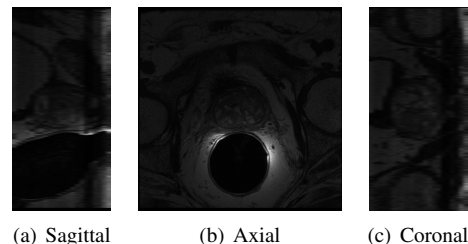


Fig. 2. 3 different views of the MRI volume

E. Visualize and compare the RAW and FOR PRESENTATION Mammography images

From the image, we can notice that the raw image only contains the contour of the breast and all the details inside are black. The for-presentation image emphasizes the details of the breast, which is what doctors need.

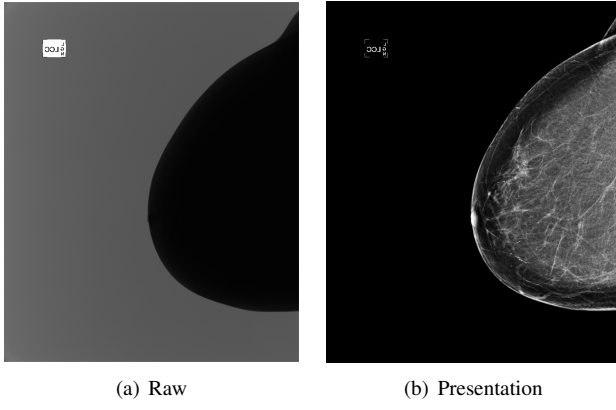


Fig. 3. Images for X-ray images

III. IMAGE TRANSFORMATION

A. What is the RAW image showing

The raw image shows only the contour of the breast and the details are invisible.

B. Steps to transform the raw images

In order to get the result similar to the Fig. 3(b), we propose an image transformation. The transformation may vary from images to images, but the main idea is to emphasize the interesting area and then increase the contrast. The step is shown as below, and each step corresponds to (a) - (f) images in Fig. 4.

Transformation steps:

- 1) Normalize the image to the range of $[0, 1]$
- 2) Inverse the normalized image: $1 - \text{raw_image}$
- 3) Threshold the inverse image
- 4) Normalize the region with detailed to $[0, 1]$ range
- 5) Adjust the intensities of the points in the detailed region
- 6) Apply Adaptive histogram equalization

IV. CONCLUSIONS

In this lab, we not only play with some basic operating of DICOM images, but also apply an image transformation to a raw breast image and acquire a decent presentation result. A reasonable transformation can give doctor a really nice presentation images to diagnose so it is important.

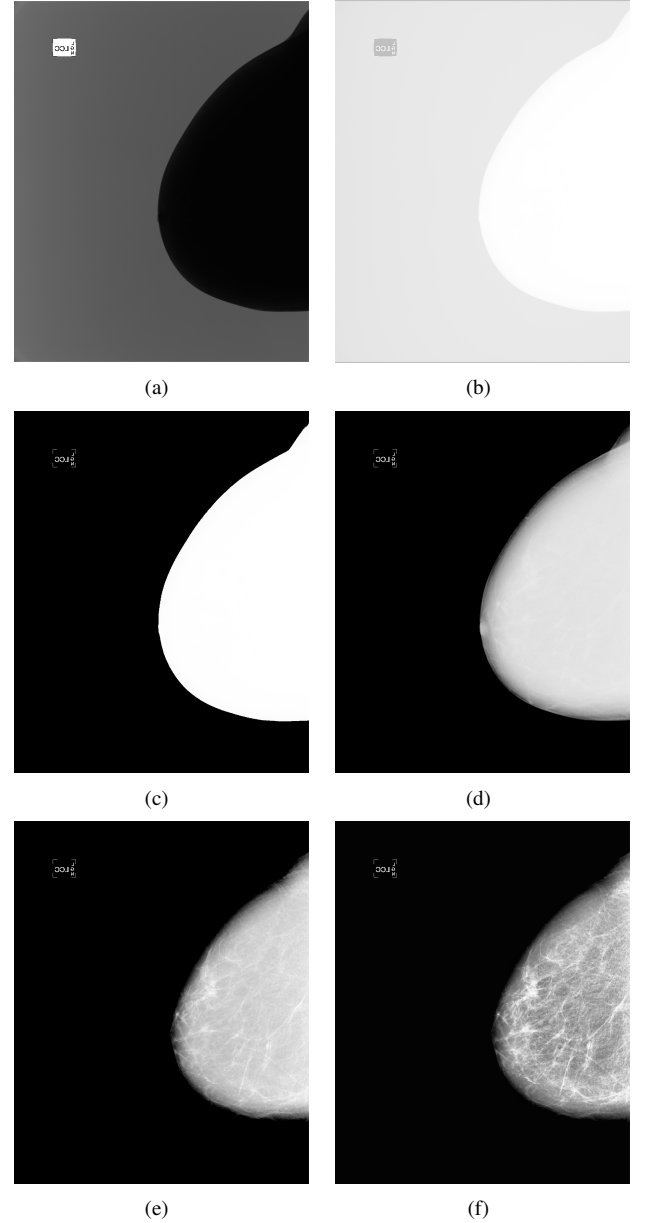


Fig. 4. Illustrations for the each step of transformation