Image Modalities: Image analysis with Mevislab

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Abstract

The main purpose of this lab is to get a general understanding of how Mevislab works, the possibilities it gives and kind of results it is returning. For this lab it will be necessary to read images, simulate noise, apply filters, use morphological operations, compute histograms and analyse results. A Dicom file for a breast analysis is given. It will be two main tasks, first one is related with the reduction of noise and second one is getting a mask for the breast.

1. Reduction of noise

Ultrasound images are specially affected by two kind of noises. First one is called *speckle* and is gives a granular appearance to an otherwise homogeneous region. Speckle reduces image contrast and detail resolution, and diminishes the ability to differentiate normal and malignant tissues. Speckle artifact reduces the conspicuity of small, low contrast lesions and masks the presence of calcifications, an important indicator of possible malignancy. The second one is *clutter*, and arises from side lobes, grating lobes, multipath reverberation, and other acoustical phenomena. Clutter consists of spurious echoes, which can often be visualized within a breast cyst. Clutter may lead to concern whether a cyst is truly simple, or whether it is a complex cyst that contains purulent matter or haemorrhage.

It is possible to visualize in the following figure the way is simulated this speckle noise with $\sigma = 0.5$ over an image, and the way to correct it. The method used to reduce the noise was a median filter with a 3x3 mask, and the original image and the result could be observed in the figure below.

To check how close it is from the original image it is possible to check the histograms for the original, noisy and filtered image.

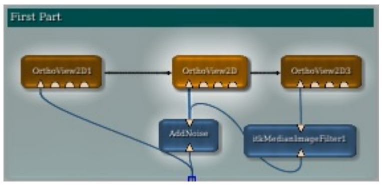

Figure 1: Simulation of noise schema

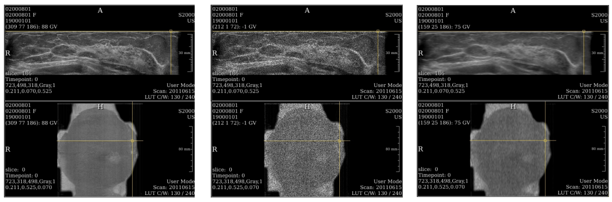

Figure 2: Original, noisy and filtered breast image

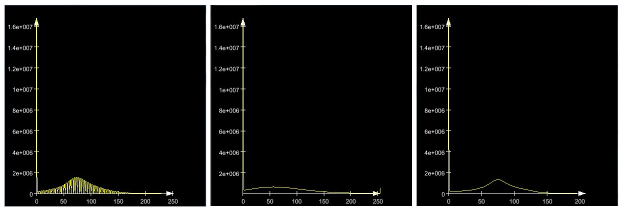

Figure 3: Original, noisy and filtered image histograms

2. Obtaining a mask

In this part of the report it is going to be described how a mask for the breast image could be obtained. As the starting point the projection image of minimum values will be used as starting point for the calculation of the mask. Several operations will be used during this process, such as *Threshold*, *Dilate*, *Erode*, *Gauss Filter*. Some others are related with the adjustment of the format, scale or view of the images.

The schema for the algorithm implemented to obtain the mask is shown in Fig. 4

For comparing the result of the mask with what was expected, the most intuitive thing is to make the

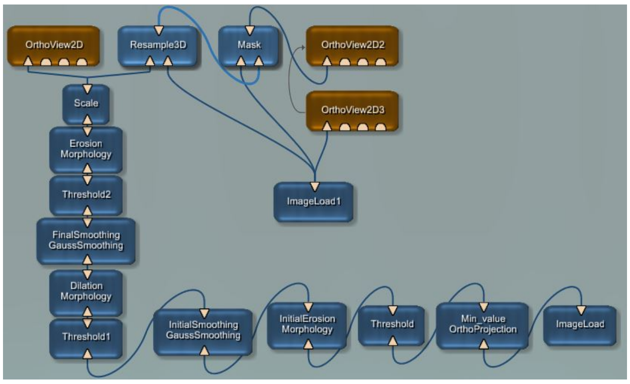

Figure 4: Mask process schema

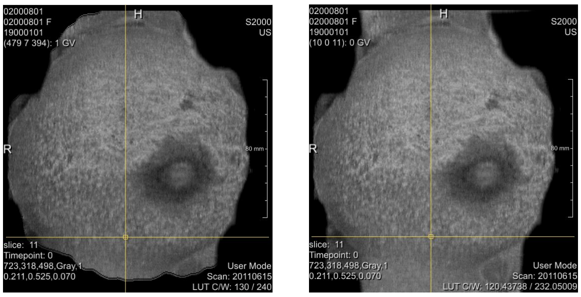

Figure 5: Original and masked slice of DICOM image

subtraction of the original mask (made by hand by the doctor) and the one obtained with the algorithm that was implemented. The following image represent the binary images of the original mask, the obtained and the subtraction of them (absolute value). One of the

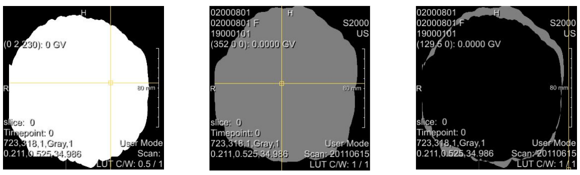

Figure 6: Original and masked slices of DICOM image '02000801'

most widely accepted way to compute the similarity between the original mask and the calculated is using what is known as DICE coefficient.

$$DICE = \frac{2\,|x \cap .y|}{|x| + |y|} \tag{1}$$

For simplicity, this coefficient will be calculated only over one slice and over one slice of the original image. Both intersection and original binary images will be studied with an histogram to get these values that will used in the formula described above.

The results obtained for the DICOM images given are collected in the following table.

Image	$\lvert x\rvert$	$\lvert y\rvert$	$\lvert x \cap y\rvert$	DICE
'02000801'	165279	159718	154116	94.84
'02001318'	179271	142997	142997	88.74

Even if the two images studied had a good result as is shown in the images and in DICE coefficient, the use of *minimum* is not recommendable. The reason could be checked in image '02001188', where the result of using this function is a black image, what means that all pixels have, at least, projection of zero value. Original mask, calculated one and difference could are shown in Fig. 7

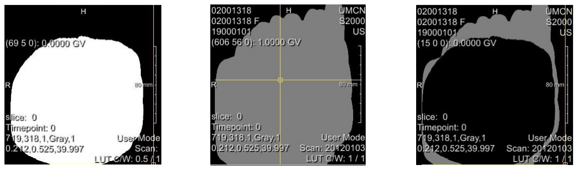

Figure 7: Original and masked slices of DICOM image '02001318'

A solution that combines minimum and maximum, or mean as the first step would be preferable instead using only minimum function.

References

[1] 'Real Time Spatial Compound Imaging in breast technology and early clinical experience' - R. Entrekin, P. Jackson, J.R. Jago and B.A. Porter