Medical Imaging
Lab 2 Report: MevisLab

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1 Introduction

The objective of this lab assignment is to get familiar with prototyping of medical imaging using MeVis-Lab program. MeVisLab is a rapid prototyping and development platform for medical image processing and visualization. It is, in fact, able to handle large, six-dimensional images, develop new algorithms or change/improve existing ones, and be integrated into clinical environments due to standard interfaces. Beside general image processing algorithms and visualization tools, MeVisLab includes advanced medical imaging modules for segmentation. Therefore, the main task in this lab sessions is to develop a breast boundary segmentation algorithm given three different 3D breast ultrasound volumes.

2 Breast Boundary Segmentation algorithm analysis

This section presents an automatic algorithm for segmenting 3D breast volumes from the background. Inspecting the given volumes in details shows that images of this type suffer usually from background effects in the outer slices, with low or high number. Thus, using one central slice could be a good step toward the main task of breast contour segmentation.

Indeed, the implemented algorithm starts by choosing one central slice in the z direction of the breast volume and then cloning this slice into the same number of slices in z direction in the input volume in order to constitute a separate volume. The next step is to threshold this volume with a low threshold, around 20, to get black and white slices, where black regions represent the background and white regions represent the breast itself. However, since the central slice may have some small brighter areas inside the breast and some separate tiny regions outside it and due to the bad effect the thresholding may have at this step that could make the image worse, it is better to smooth this slice with an averaging kernel before thresholding it. In fact, taking a look at the result of the thresholding step shows in some cases small holes inside the breast, depending on the original volume, which requires some processing by the "closing" morphological operation. To perform this operation two steps are necessary. The first one is to do dilation by spherical kernel of appropriate size, chosen to be around 25*25, and the second one is to do erosion by another spherical kernel of approximately the same size. Hence, the dilation closes the opened areas inside the breast and enlarges the breast as well. However, the erosion shrinks the boundary of the breast again and preserve the rest.

Thereafter, the thresholded volume is used to alter the original one by means of arithmetic multiplication. The purpose of this step is to remove the background in all slices in the original volume since they are totally black in the modified volume, have zero intensity value, and preserve the breast region because it is white in the modified volume, have 65536(uint16) intensity value. Figure 1 shows the blocks used to implement the method that is just explained in MeVisLab.
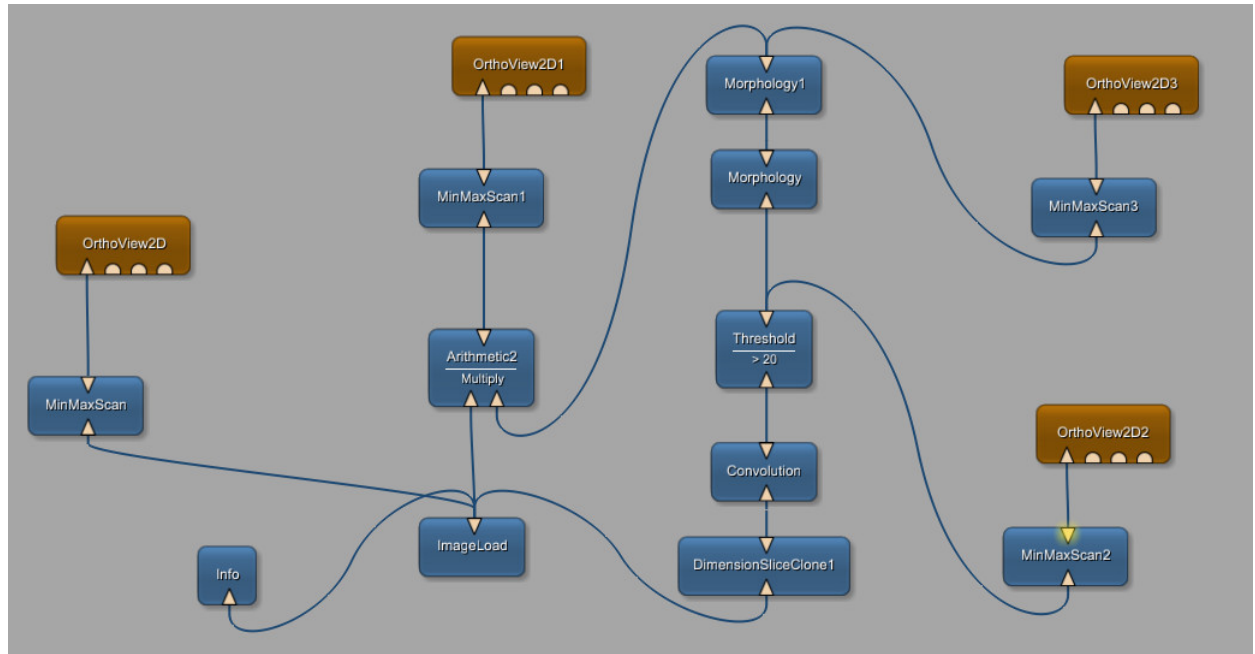
Figure 1: MeVisLab blocks for implementing automatic breast boundary segmentation

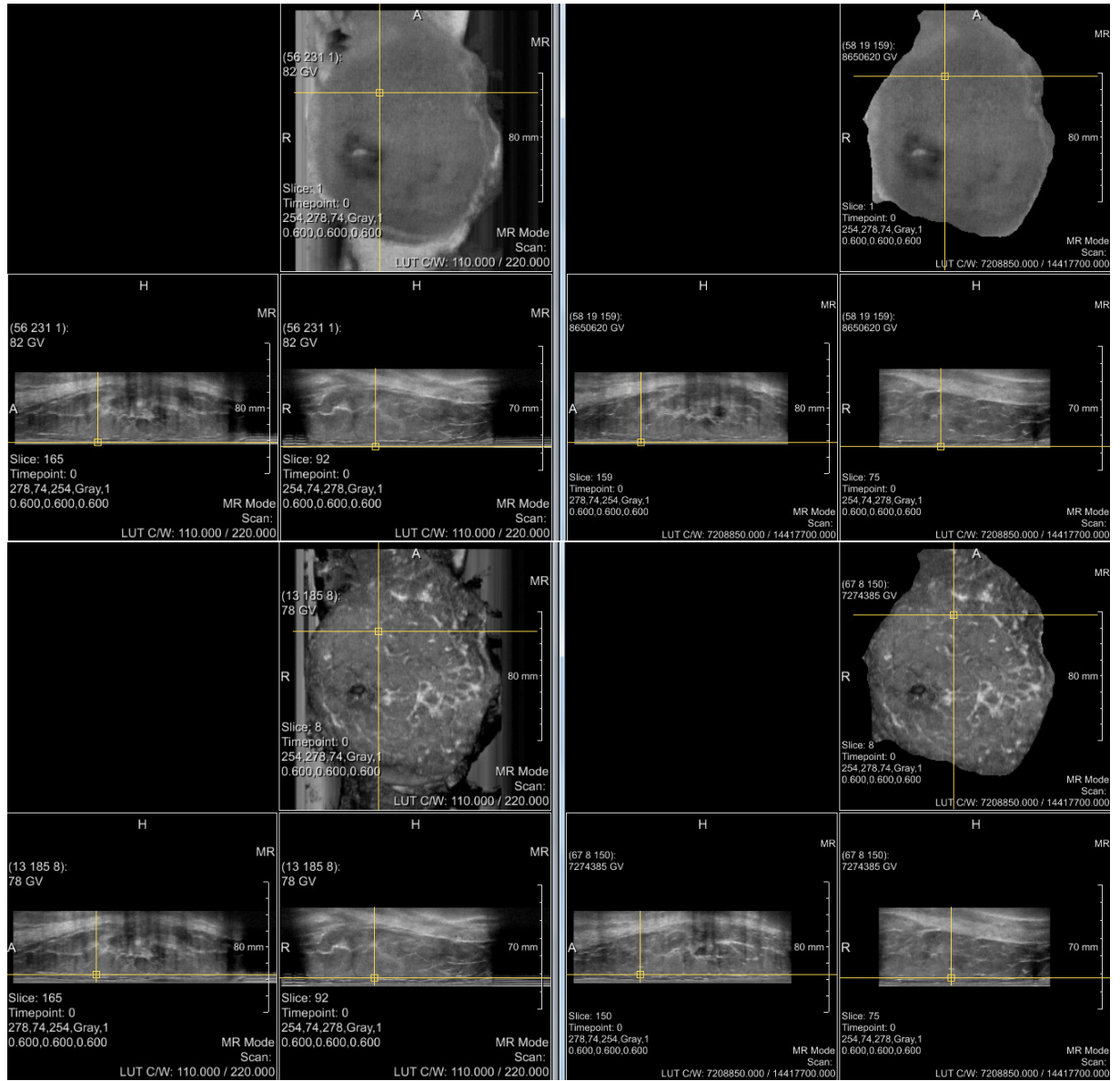The following three figures show three different breast volumes along with their segmentation result.

Figure 2: breast boundary segmentation results for the first volume: original (left) and segmented (right) volumes
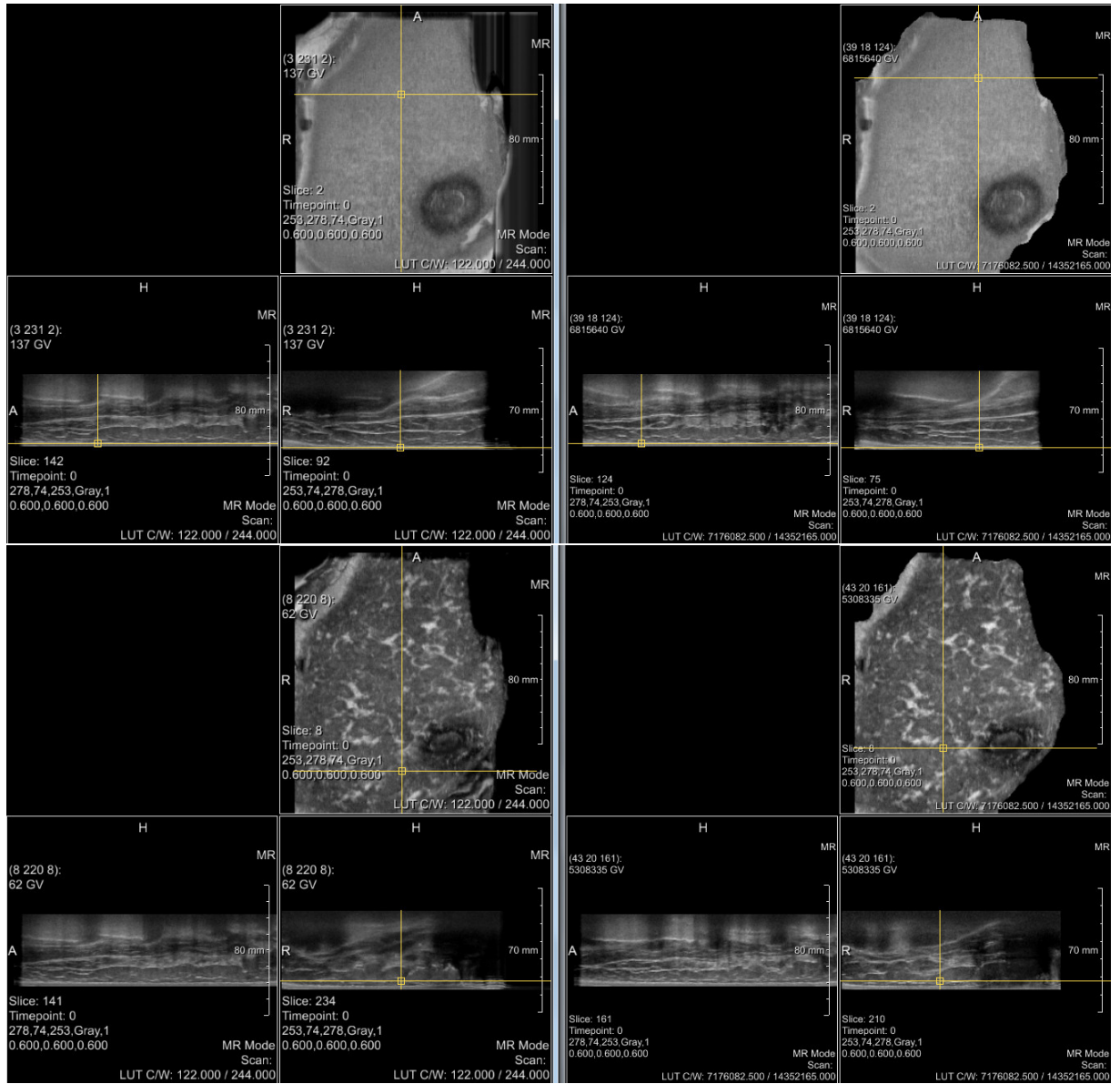
Figure 3: breast boundary segmentation results for the second volume: original (left) and segmented (right) volumes
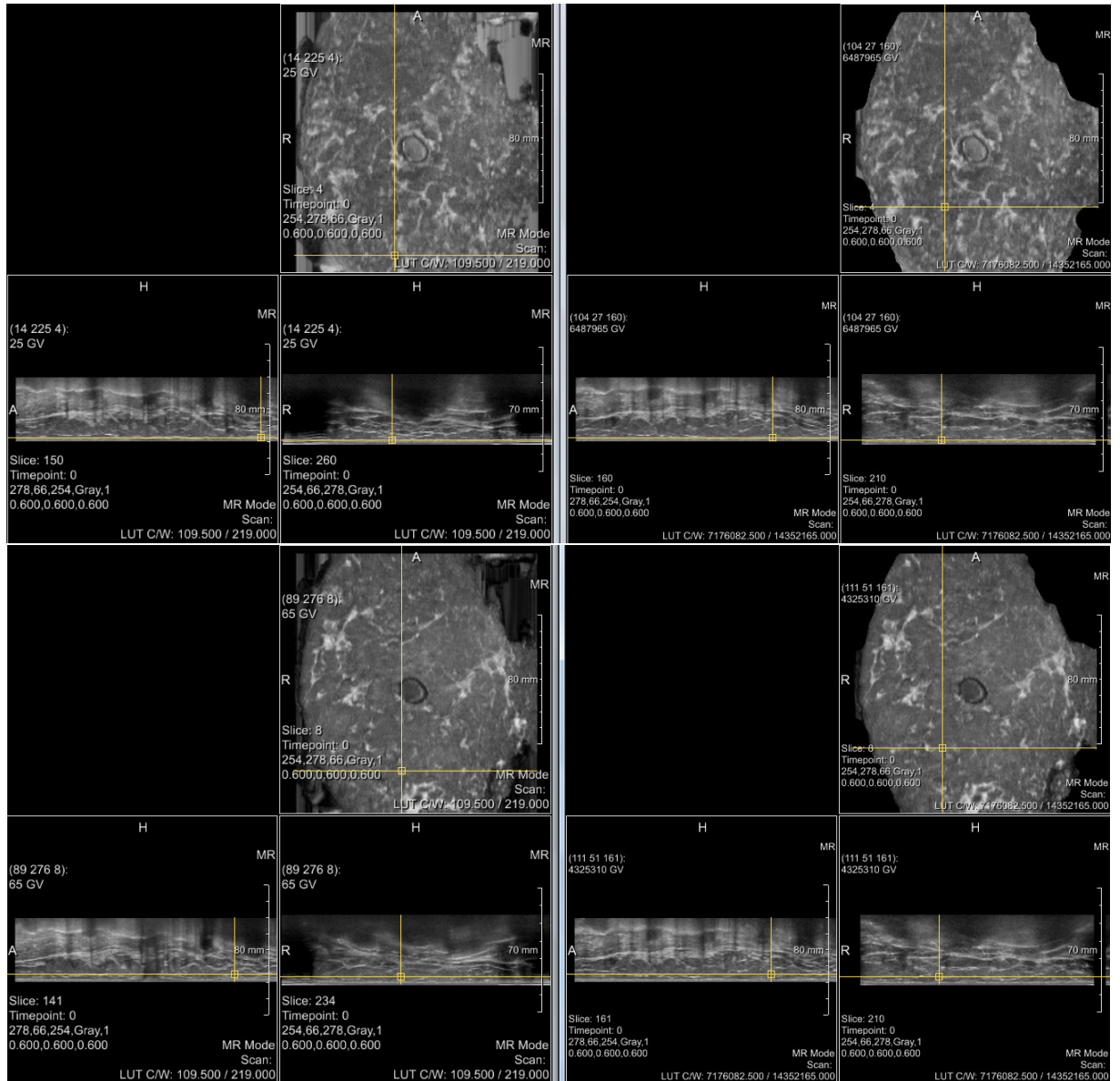
Figure 4: breast boundary segmentation results for the third volume: original (left) and segmented (right) volumes

3   Conclusion

During this lab sessions an algorithm for breast boundary segmentation is implemented successfully in MevisLab program. The algorithm has the advantage that it does not need any human intervention for getting good results. However, sometimes a slightly better results and time response could be obtained by adjusting a little some parameters like threshold value, size of smoothing and morphological kernels.