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New methodology to enhance 3D segmentation for CT biomedical volume data images

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Abstract

This paper explains in brief a trick to enhance a 3D segmentation for any given CT (Computed Tomographic) volume data images. The main idea is to include two preprocessing steps before construction 3D objects, the preprocessing steps are included in this methodology, so it will not effect or disturb the original image. At the end of this work a collection of results are collected from different views to show us the differences between the new measures and the previous techniques.

Keywords: 3D segmentation, segmentation enhancement, CT volume rendering.

Introduction

The first step in any image analysis endeavor is to simplify the image, reducing it to its basic component elements or objects. This is the domain of image segmentation operations. A segmentation operation is any operation that highlights or, in some way isolates, individual objects within an image. The goal of segmentation operations is to simplify the image without discarding important image features. The definition of "important image features" generally depends on application's particular requirements.

We use Analyze software as a comprehensive visualization for biomedical imaging to construct 3D objects, segmentation and threshold. In this work threshold technique are used to compare the original image with the elements or regions that need to extract;

threshold techniques which make decisions based on local pixel information are effective when the intensity levels of the objects fall squarely outside the range of levels in the background. Because spatial information is ignored, however, blurred region boundaries can create havoc.

The methodology of enhancement

In this paragraph I will explain by steps, the main methodology (trick) for this work. Figure (1) below, shows us a sample chart, how to obtain 3D segmentation volume data from given CT biomedical image.

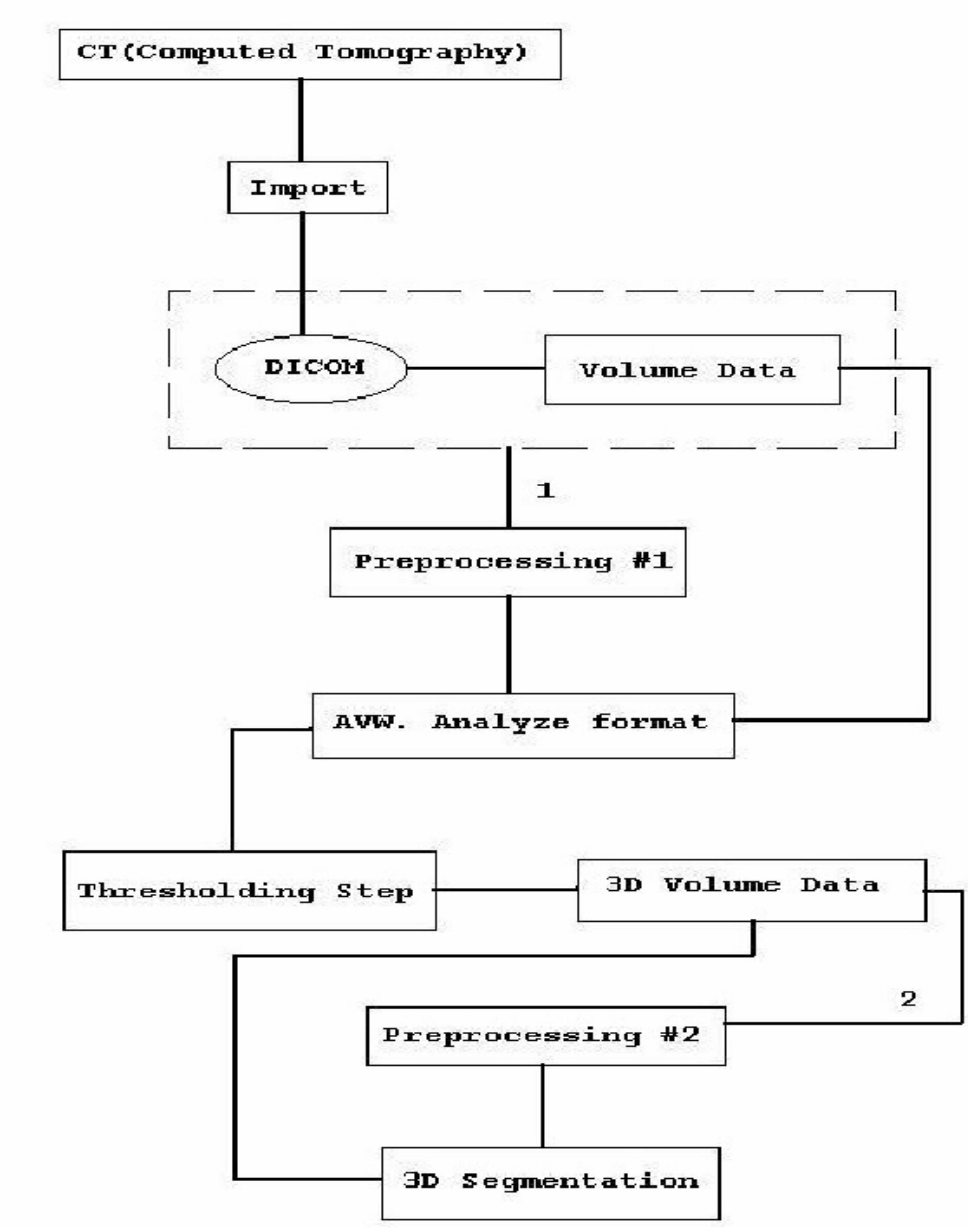


Figure (1) Obtain 3D segmentation volume data from given CT biomedical image.

This work based on volume data that acquired from CT biomedical machine. As shown in the figure (1) above, all what we need is to add pre-processing step after volume data rendering and before save the work to Analyze format. Thresholding and construction 3D volume data is the second part. Figure (2) below, shows us two image for CT (Head-Transaxial view), the image at the left is the original image, the one at right is after pre-processing step number 1, where we applied histogram normalization as median histogram.

The Histogram Operations module performs three basic point operations, which alter the shape of the gray level histogram of the image. In general, the program will map gray levels from the input range in to any output range having the same or fewer levels. Either 8- or 16-bit images may be used as input to the process, and the program will determine from the specified output minimum and maximum whether the output is an 8- or 16-bit image.

The operations may be performed over the entire volume histogram (applying the same transformation to each slice), or on a slice-by-slice basis (calculating a different transformation for each slice). Figure (3) show us also the results after volume data rendering for CT image, the volume rendering based on Thresholding values, we applied the same values for both cases (before pre-processing step 1 and after pre-processing).

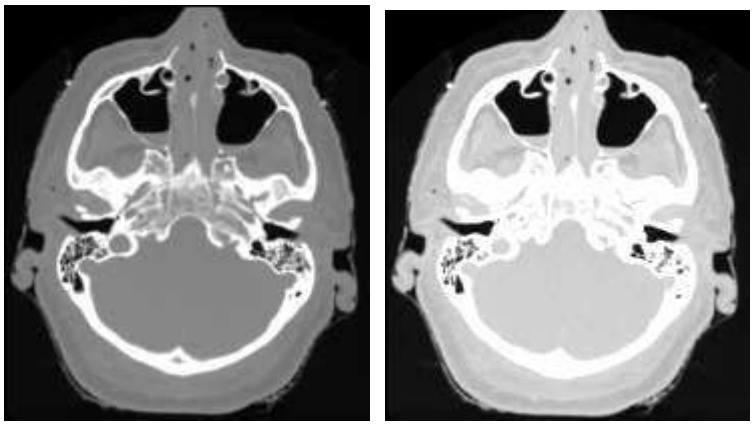


Figure (2) image at the left is the original image, at right is after pre-processing step number 1 (histogram normalization as median histogram)

Figure (3) results after volume data rendering based on Thresholding, left image at Thresholding values (min 240 max 255) before pre-processing, right image Thresholding values (min 240 max 255) after pre-processing number 1.

Now to go forward to the second part where pre-processing number 2, rendering CT volume data image based on Thresholding is required, in Analyze the Volume Render module uses ray casting algorithms to very rapidly generate volume rendered displays.

In pre-processing step number 2, unsharpening enhancement technique is applied after threshold volume rendering. As shown in figure (4) below, a captured image at left for the same frame slide of the original image in figure (1) above, looks clear smoothed after unsharpening enhancement, right image in the same figure (4) captured after low pass filtering. Both images look same but actually there are some different. Any single technique is considered as pre-processing step in this part. We will continue our work by selecting the first image at the left in figure (4) that has been captured from volume data set.

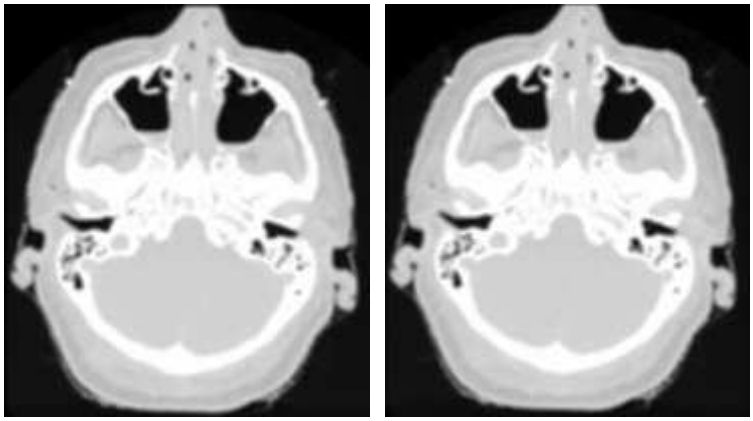


Figure (4) Left image after unsharpening enhancement, right image after low pass filtering

Finally and in safe, we can extract any region of interest (ROI) from the volume data set by auto trace or by manual segmentation. The Object Extractor module in Analyze enables the definition and extraction of objects from the current volume using thresholding, region growing and morphological operations, a sample step exist in figure (5) showing us region of interest (ROI) after selection. Figure (6-a) the result after rendering CT volume data set before any pre-processing step, figure (6-b) the result after rendering the same CT volume data set, but after the two pre-processing steps. Clear differences appear in the figure, if we make comparison between all the views.

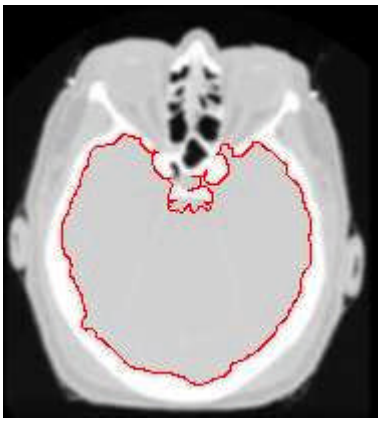
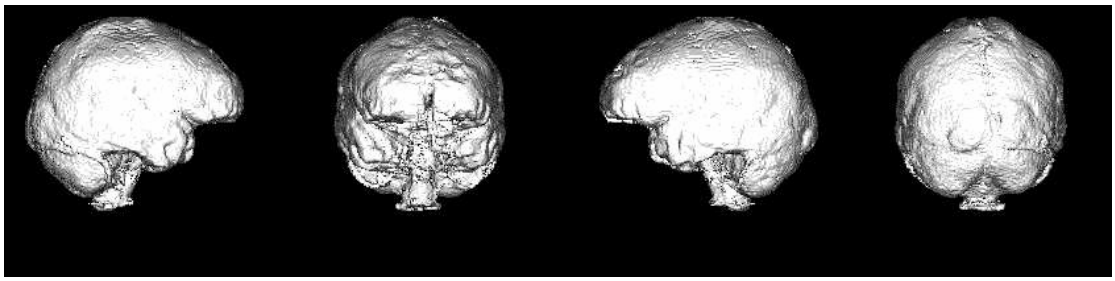
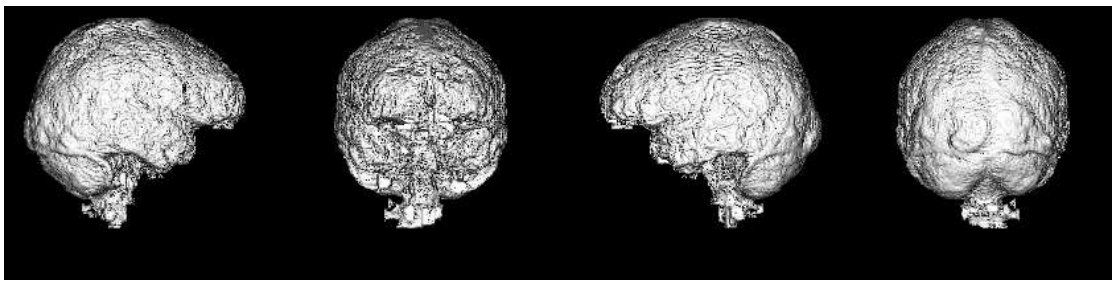


Figure (5) Region of Select (ROI) using Auto-trace



(a)



(b)

Figure (6-a) the result after rendering CT volume data set, before any pre-processing step. Figure (6-b) the result after rendering CT volume data set, but after the two pre-processing steps.

Conclusion

It is important in segmentation, generally, to make sure that this process does not remove any significant information about the objects being analyzed; pre-processing operations must not degrade the image in ways that will interfere with the overall image analysis goals of the applications. This paper gives some ideas about how to pre-process biomedical imaging without degraded the given image, however this work uses 3D segmentation to show different views of the results as part of the main purpose.

References

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