Medical Image Segmentation

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CSE 420: BioMedical Image Computing

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1. Introduction

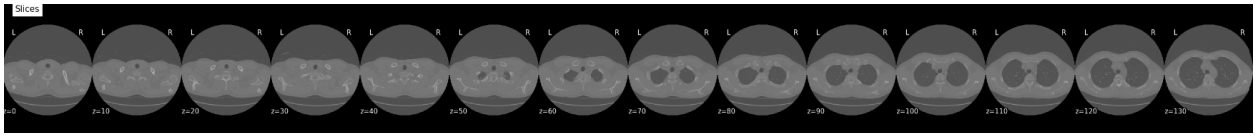
Medical image segmentation is a fundamental task in the field of medical image analysis. It involves the process of partitioning or segmenting a medical image into multiple regions or structures of interest, such as organs, tissues, tumors, blood vessels, or anomalies. The primary goal of medical image segmentation is to extract meaningful and diagnostically relevant information from medical images for various clinical and research applications.

This project sets out to utilize and evaluate two different methods of medical image segmentation for CT Scans of lungs and airways.

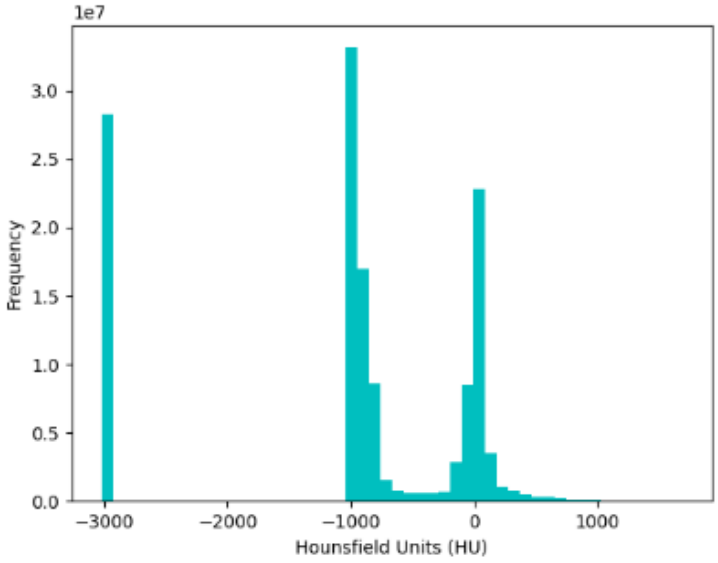
2. Approach

2.1. Task I: Programming

To compare the segmentation methods, slices from a CT scan are read as .dicom files and processed. There were 508 .dicom images in total, and some of the slices are shown below:



The two methods chosen to perform the segmentation were hybrid segmentation and region-growing segmentation. To begin, a histogram was plotted for the frequency against the Hounsfield Units of the scan. This provides us with data that will be useful during the segmentation processes.

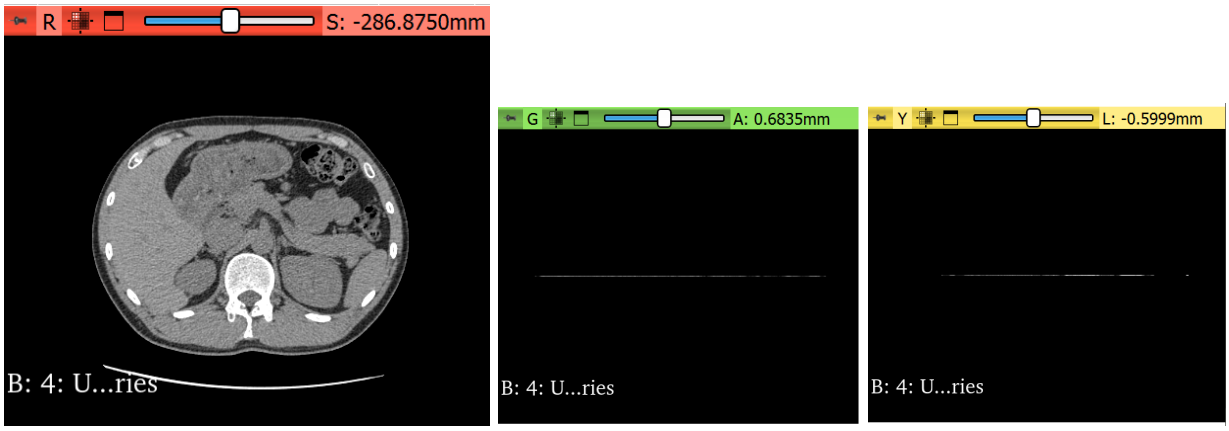


Hybrid segmentation is carried out by performing some preprocessing on the image data: the image data is rotated to the correct orientation, and then resampled to a specified voxel spacing. Lung mask segmentation is applied to the image data by standardizing the pixel values, thresholding the image to separate lung/air from soft tissue/bone, applying erosion and dilation to refine the mask, labeling and filtering regions to isolate the lungs, and visualize the mask and apply it to the original image.

During the process of region-growing, there was difficulty in determining the values of the seed points. Several methods were attempted, but none yielded valid results. One method which was attempted, was determining the seed points within the specified range by thresholding. After running several ranges, a lower threshold of -1100 and upper threshold of -300 were settled on. The output generated from this process of thresholding is included in the results below.

2.2. Task II: Software Usage

The CT scan data was loaded into the 3D slicer. The resulting axial, coronal, and sagittal views are as follows respectively:

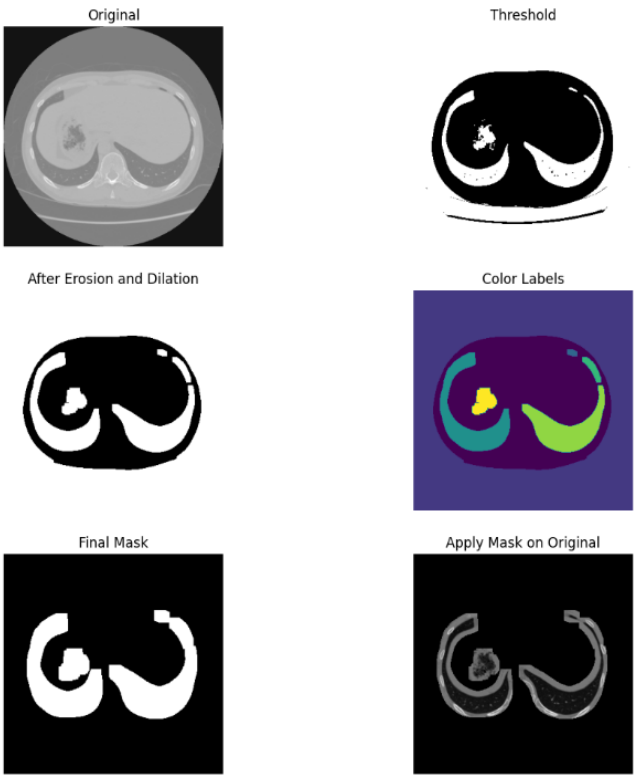


The three views were linked and made visible in the 3D view. Results are discussed in the section below.

3. Results

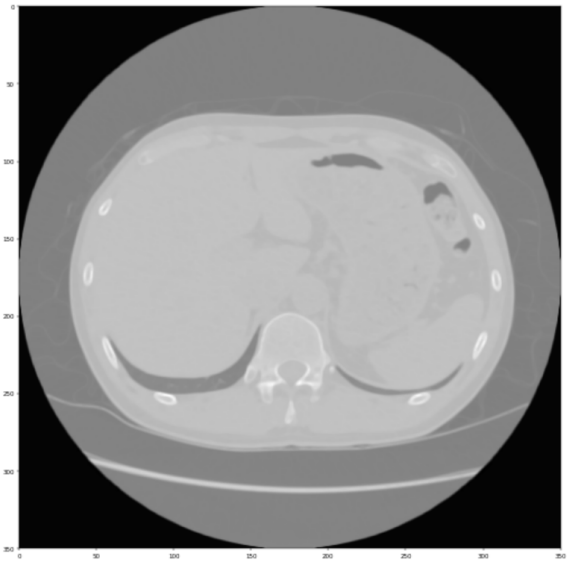
3.1. Task I: Programming

Below are the results of the hybrid segmentation process:



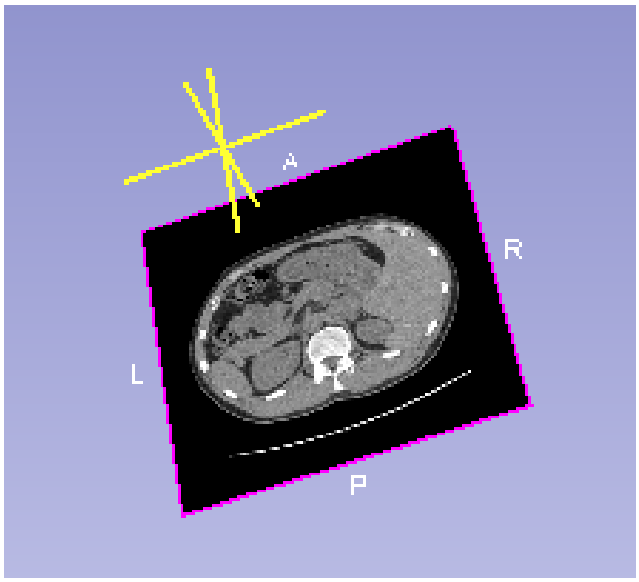
The thresholded image generated while attempting to determine the seed points for region growing, is as follows:

This image is generated by performing thresholding on the slice below:



3.2. Task II: Software Usage

The results of the 3D visualization of the CT scan is as follows:



4. Analysis and Conclusions

Both methods provided results that allow the identification and isolation of specific organs or regions of interest within an image. Hybrid segmentation offers a

variety of tools such as color labels, masks, and more, making it a versatile approach for medical image segmentation. My attempt at region-growing, while not entirely successful, produced valuable insights. The thresholding step in the region-growing process generated informative results.

Comparatively, hybrid segmentation appears to be a more robust approach, producing visually compelling and diagnostically meaningful outcomes. The standardization, thresholding, erosion, dilation, labeling, and filtering steps collectively contribute to its effectiveness. While the region-growing method had its challenges, particularly in the determination of suitable seed points, it remains a promising avenue for further exploration. Refinements in seed point selection and tuning of thresholding parameters could lead to improved results. This demonstrates the potential for the region-growing method in medical image segmentation.

In the future, additional strategies for seed point selection and range determination for region-growing should be explored to fully harness its capabilities. Nevertheless, the combined use of hybrid and region-growing methods showcases the versatility and adaptability of medical image segmentation techniques in improving clinical and research applications.