IMAGE SEGMENTATION ON A SPINAL CORD DICOM IMAGE

Literature Search:

I read a lot of documents for image segmentation using both MATLAB and Machine Learning. On the first day, I performed segmentation on the .jpg image as it seemed fairly easy to do so. I used the simple automatic edge detection and thresholding techniques. However, the results were far from expected. I read about the Cell Detection using MATLAB [12] document on the web and used that as an inspiration for my next step. Now, I used the dicom file to perform image segmentation. I saw a few Youtube videos which performed image segmentation using MATLAB [4,5,6]. MATLAB is a very powerful tool for medical analysis [9], however I needed a more specific segmentation algorithm to use for this project. Hence, I started to look for powerful Machine Learning models as my plan was to create a trained model to perform segmentation on the spinal cord image. However, while searching for some inspiration I read about the Bus Segmentation Algorithm of MATLAB. [13] This method caught my eye as it clearly gave results which I was looking for. However, I did not want to use the entire algorithm hence, I used the DPAD function which gave better and quick results for this project. I created a new model which used parts of the Bus Segmentation Algorithm and this model has given me the best results so far. So far, I have created 3 methods for Image Segmentation using MATLAB. One performed segmentation on the .jpg while the other two performed on the .dcm file and gave better results.

Methods:

JPG Segmentation:

For Image Segmentation, I first read the .jpg image. Since this image is considered as an RGB image by the MATLAB software, I first converted it into a grayscale image for further segmentation. I considered 2 types of edge detections 'prewitt' and 'sobel' as all other detectors, namely, 'roberts', 'log', 'canny', 'zerocross' performed way below expectations [8]. After thresholding, a fudgefactor of 0.5 was considered for further edge detection. Furthermore, dilation and erosion was then performed on the image. I then gave an outline on the edges for clear visualisation.

DICOM Segmentation:

For Dicom File Segmentation, I first read the .dcm file. I cropped the image to focus more on the spinal cord. Erosion was performed on the image and a manual thresholding was applied. The image was then dilated after converting the image into a grayscale one. Edge detection was performed and the image was dilated for the second time. The outputs through a manual thresholding gave out better results than the prewitt and sobel edge automatic edge detection in the previous method. This method took inspiration from [12].

Dicom Segmentation using DPAD:

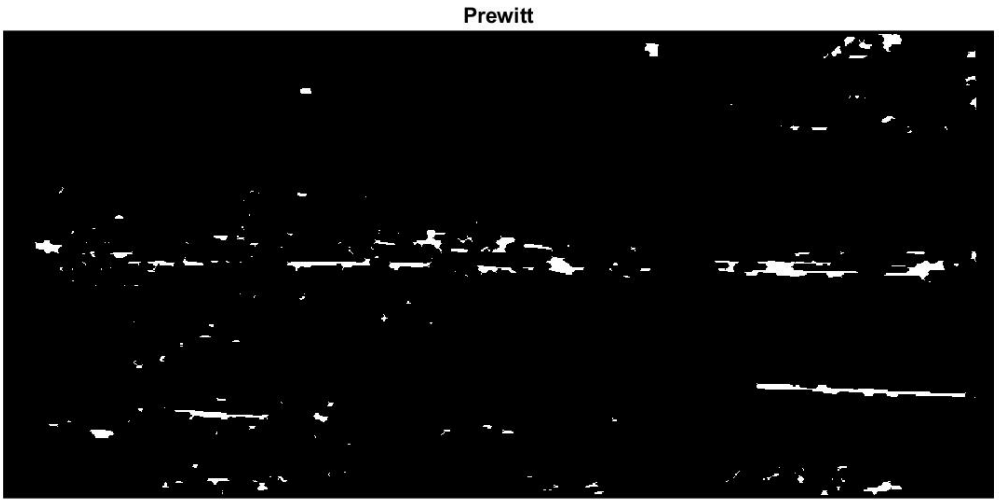
This method was partially inspired by the Bus Segmentation Method [13]. I first read the .dcm file. I cropped the image to focus more on the spinal cord. Then a double precision function was performed on the image and the image was then adjusted. The image was converted to grayscale

and DPAD (Detail Preserving Anosotropic Diffusion) [14] was performed. The image was then binarized and small holes were 'filled' for a clear and visible output.

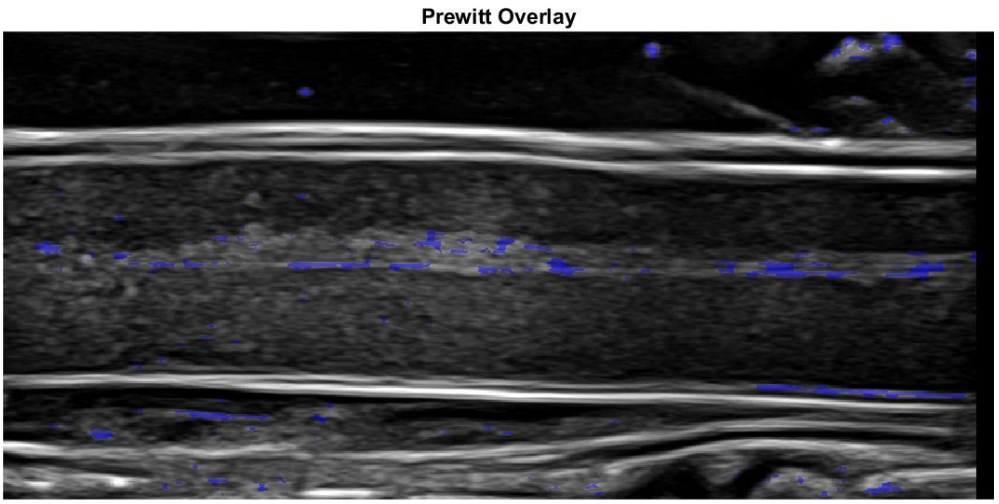
Results:

Here, I have attached all the final outputs of each of the three methods I used for segmentation.

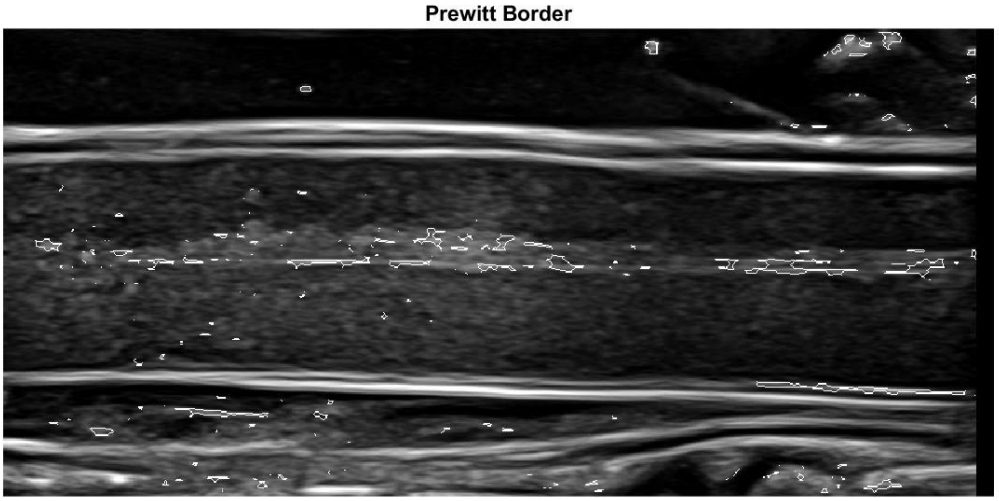
1. **JPG:**
    a. **Prewitt:**



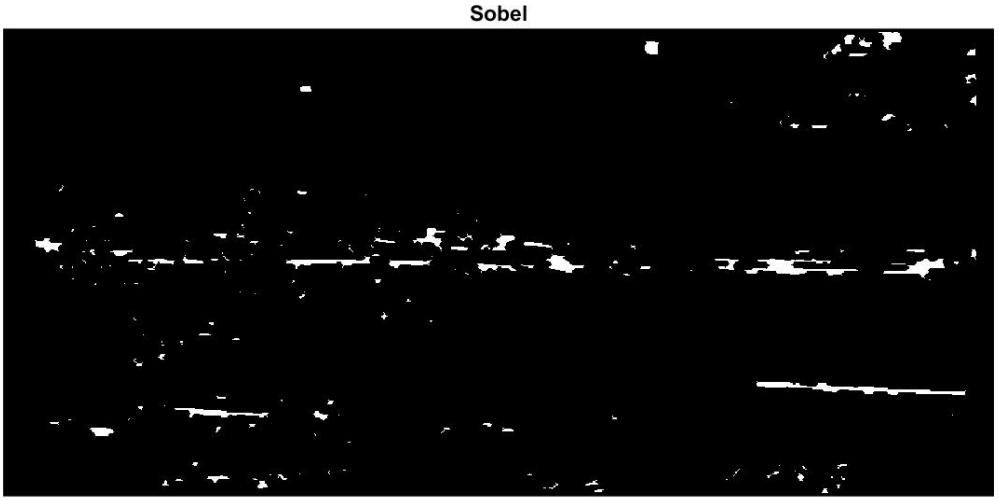
    b. **Prewitt Overlay:**



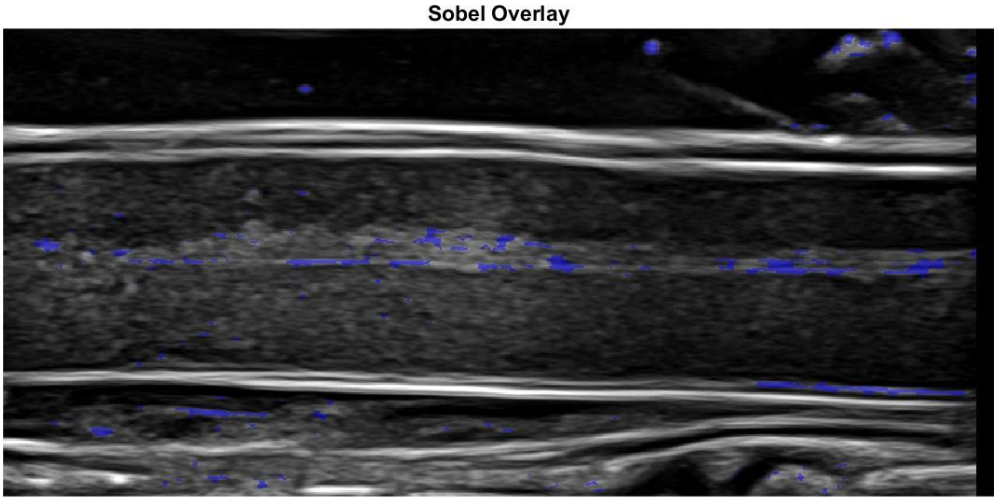
c. Prewitt Border:



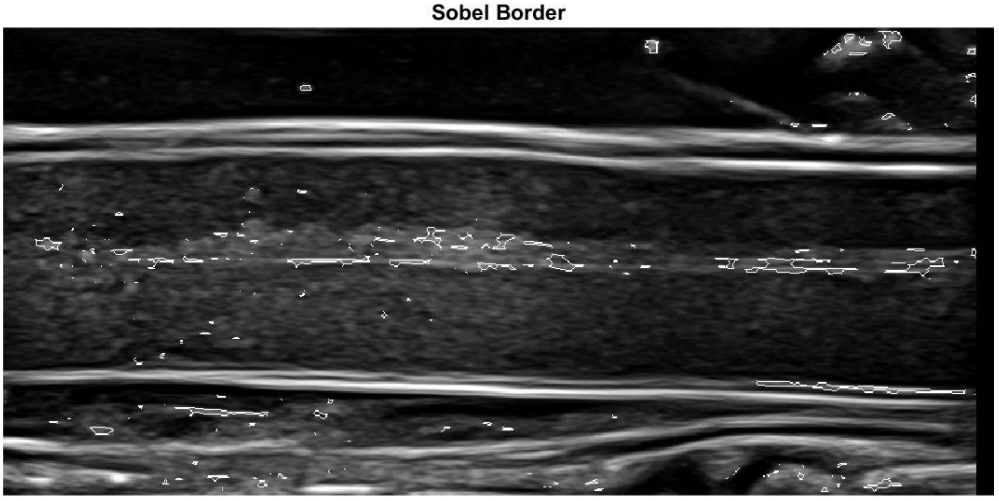
d. Sobel:



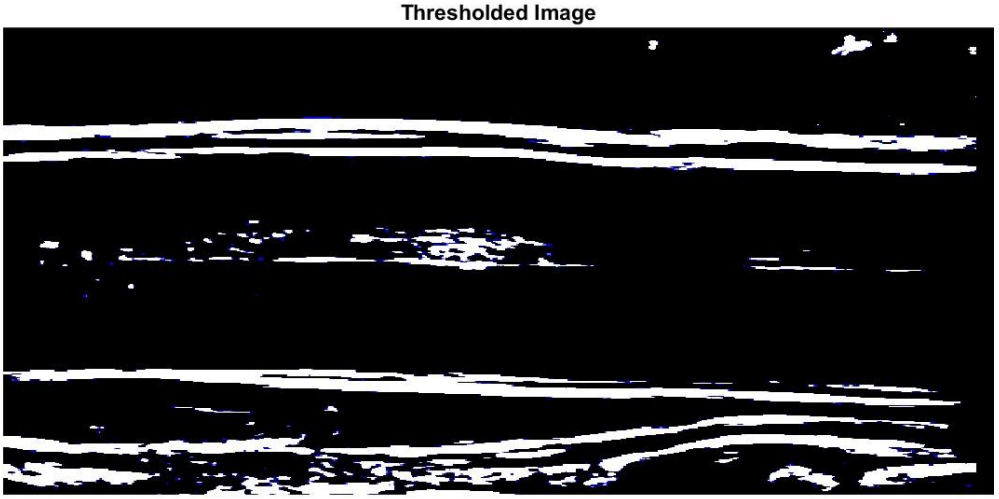
e. Sobel Overlay:

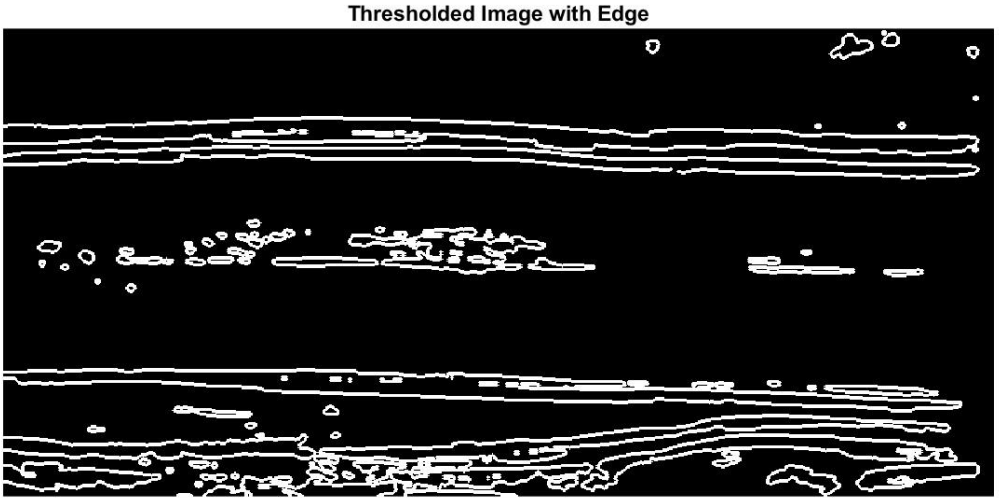


f. Sobel Border:



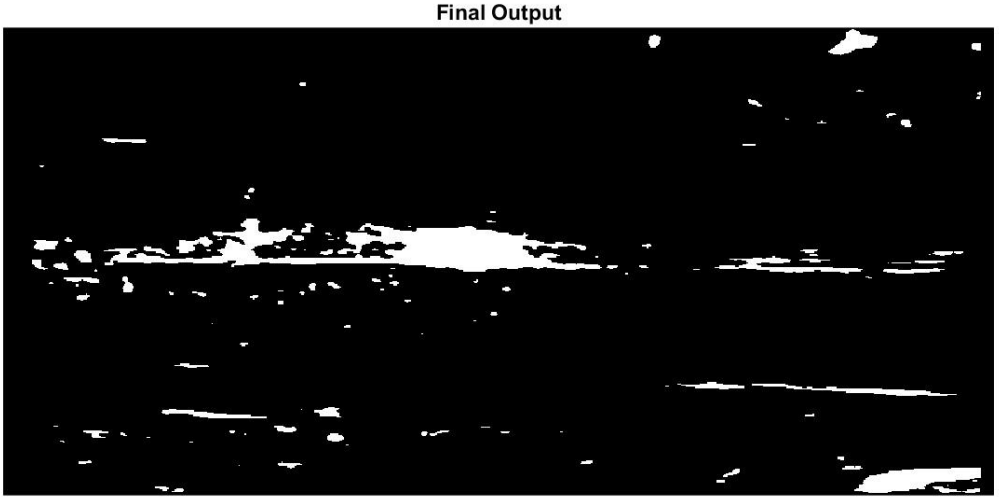
2. Dicom:



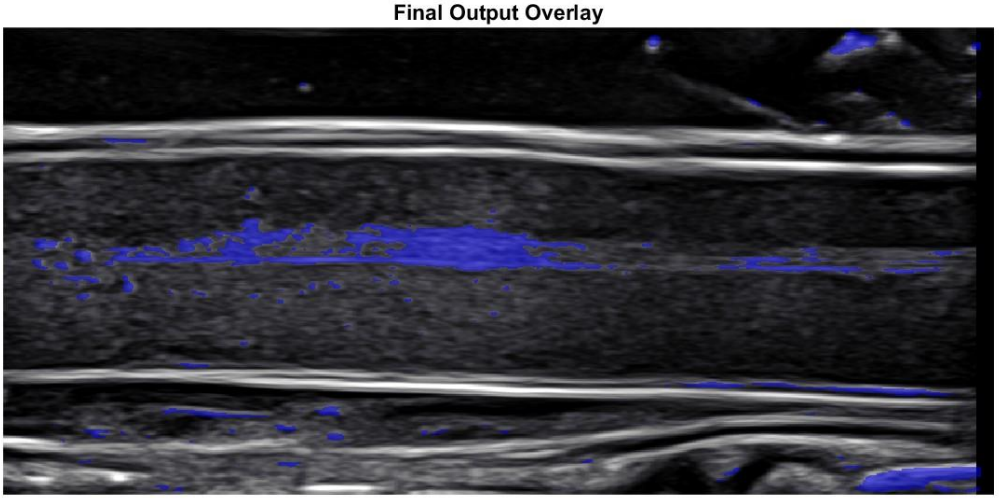


3. Dicom using DPAD:

Final Output



Final Output Overlay



References:

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12. https://www.mathworks.com/help/images/detecting-a-cell-using-image-segmentation.html
13. https://arxiv.org/pdf/1609.08364.pdf
14. Detail Preserving Anosotropic Diffusion for Speckle Filtering (DPAD) - File Exchange - MATLAB Central (mathworks.com)