Samuel George
Comp 775, Assignment 2

Assignment Two

Comp 775

Samuel George

I have neither given, nor received, unauthorized aid on this assignment. Worked with Christopher Bender and Jack Shi in developing the algorithms and understanding to do the assignment. No code was directly shared.

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Part 1:

Below are several pairs of different segmentations using geodesic snakes in ITK-Snap. As we can see quality can vary heavily depending on Image quality. I started with the very good examples and worked to worse.

Image 1:

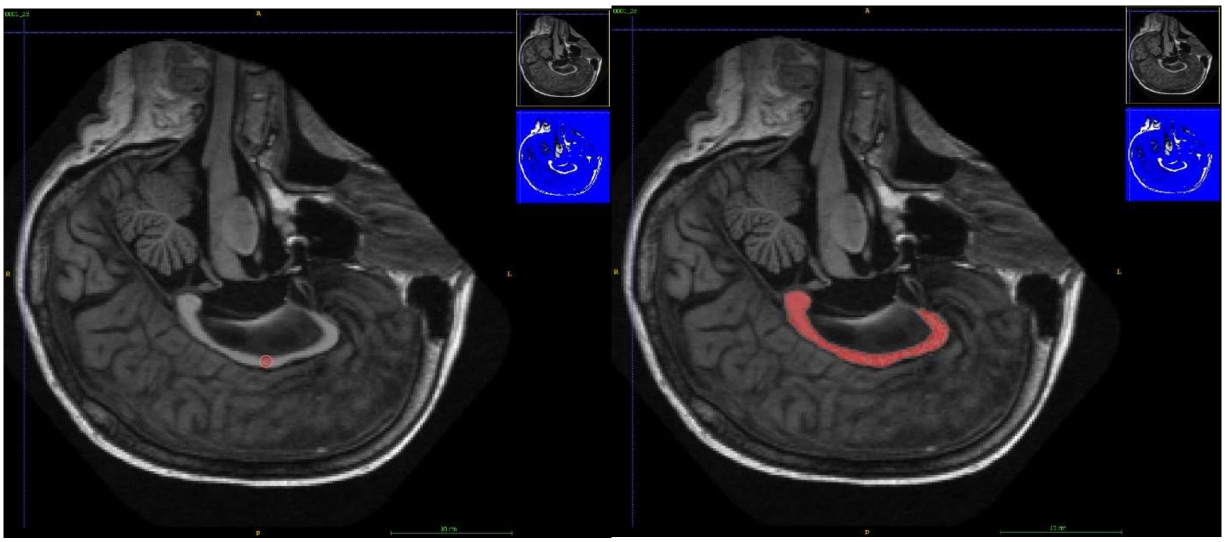

Image 2:

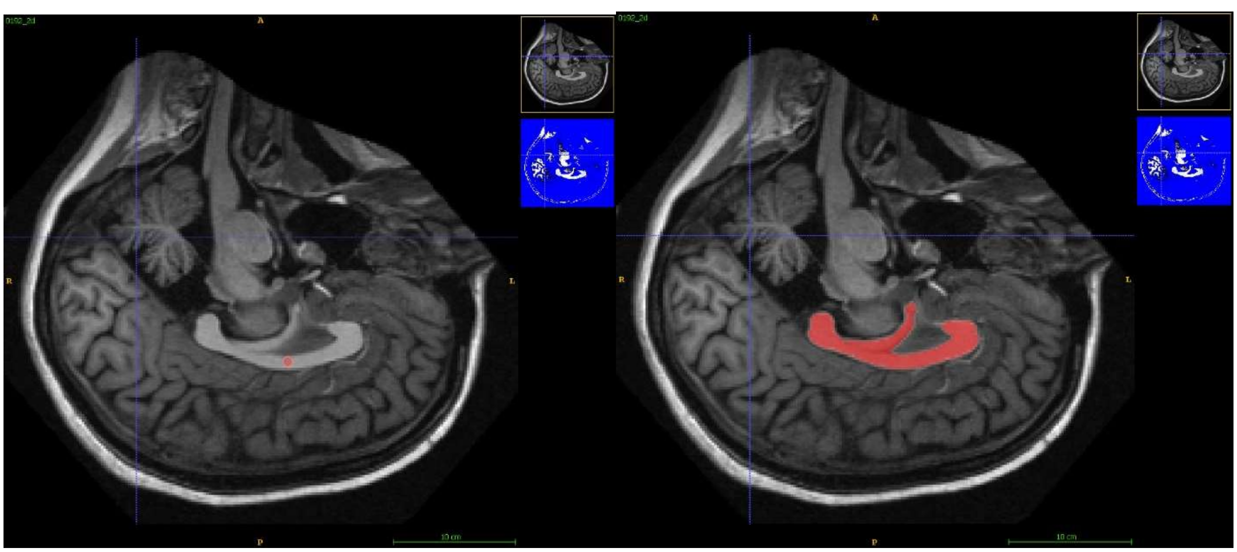

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Image 3:

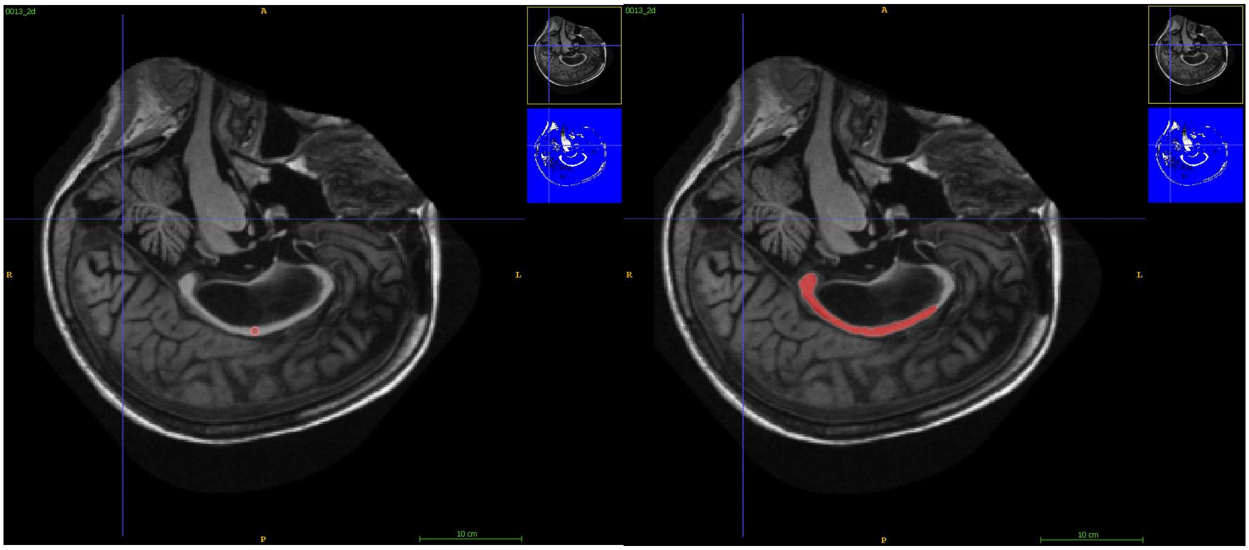

Image 4:

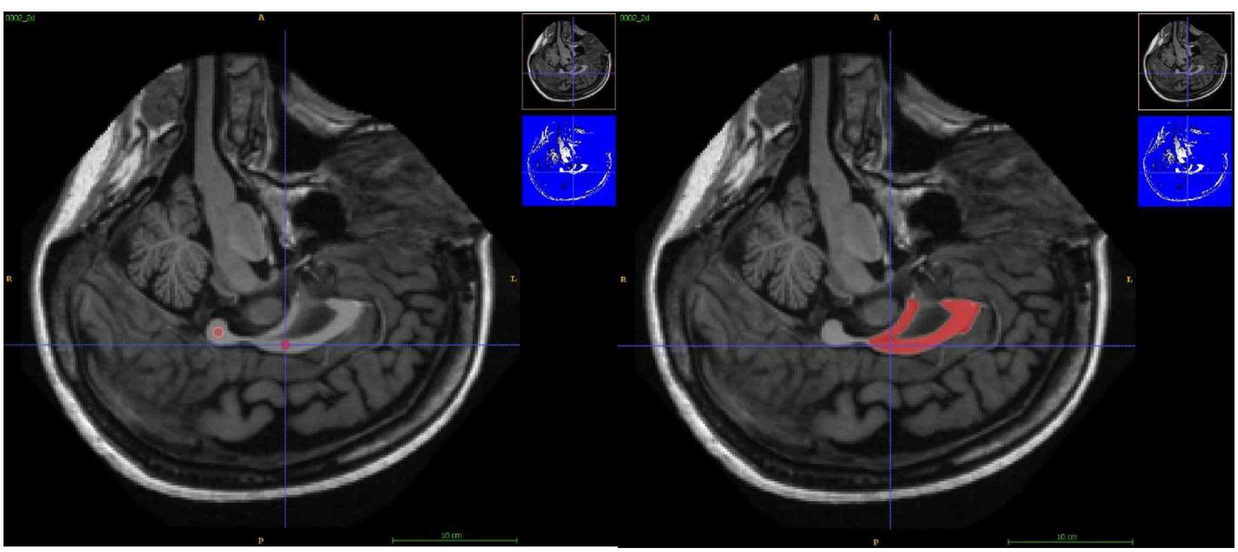

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Image 5:

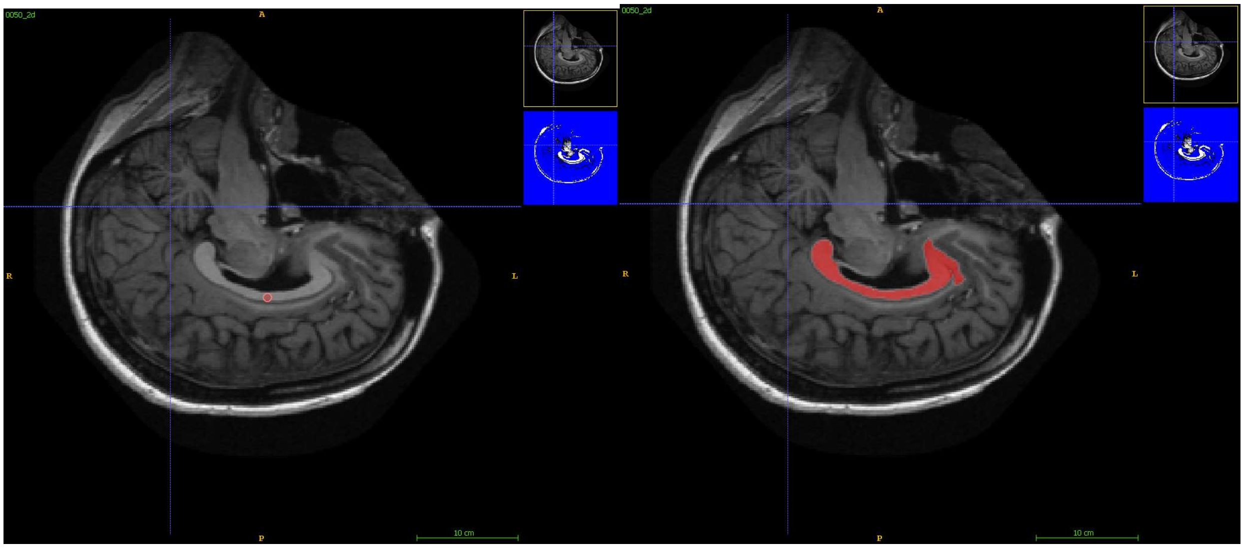
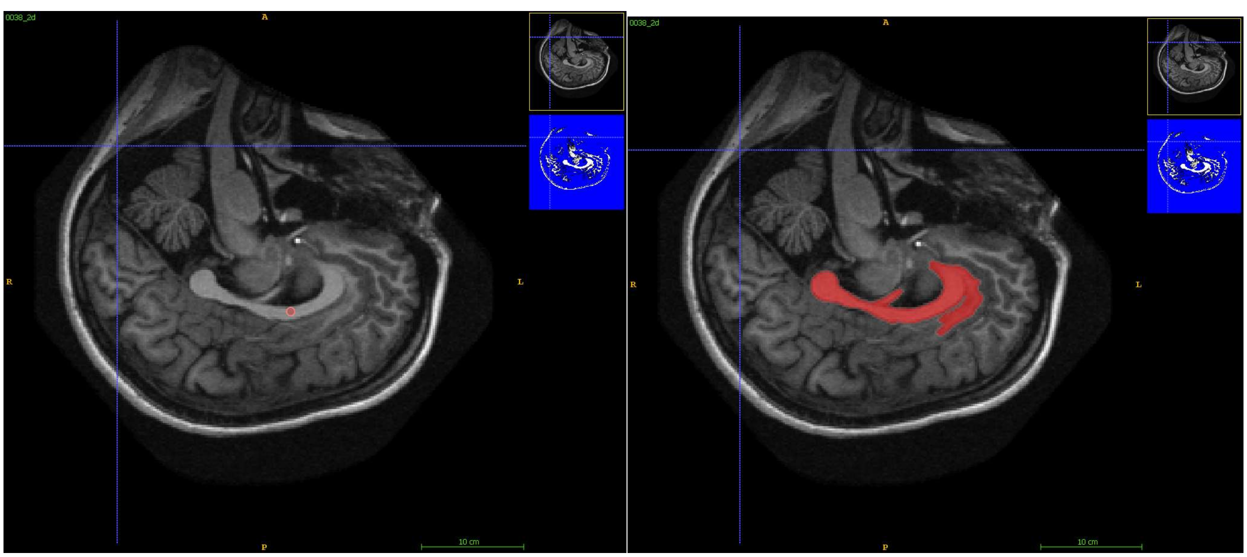


Image 6:



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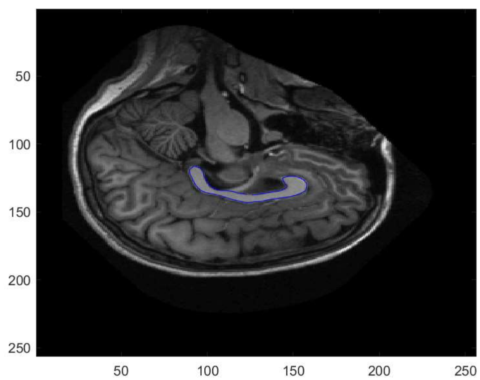
Part 2:

Below are the 8 segmentations results from testing using our ASM code. All code is located online as well as a main_script that depicts an example of building a shape space and doing training on a sample image. Left image is the initial shape from correctPDM while right is after running the algorithm.

Image 1:



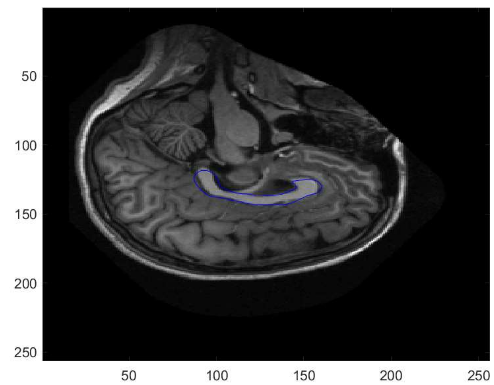
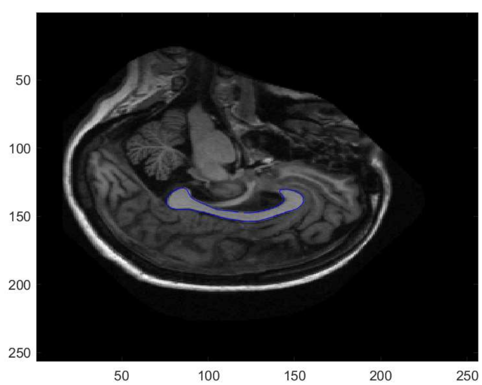


Image 2:



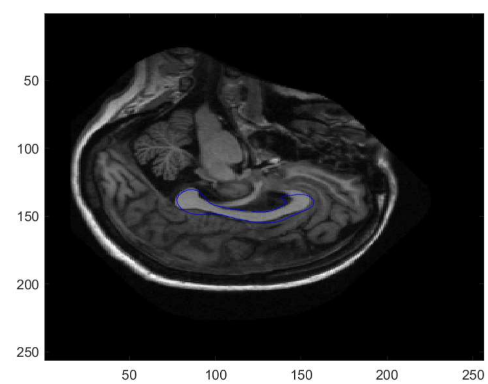
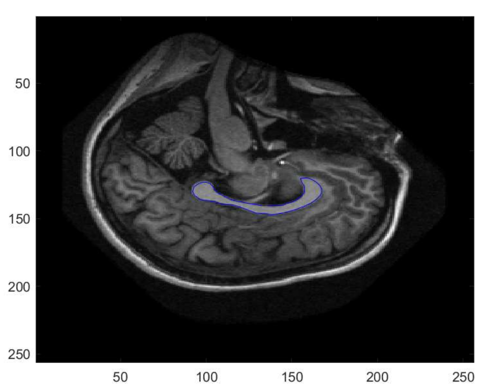


Image 3:



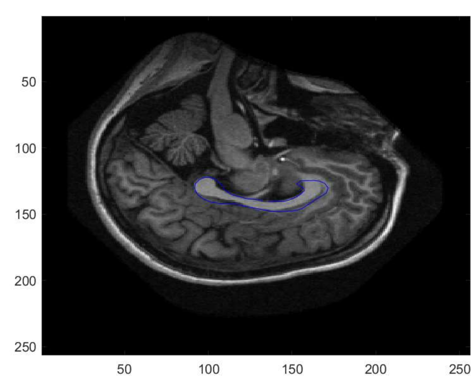


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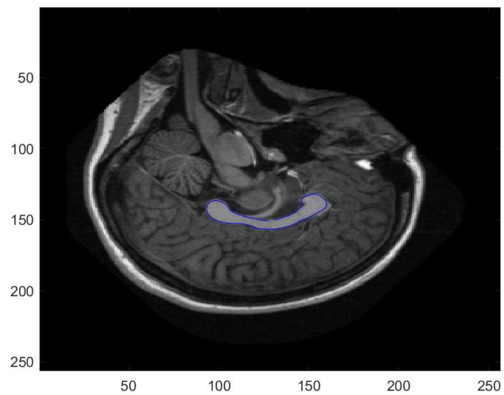
Image 4:



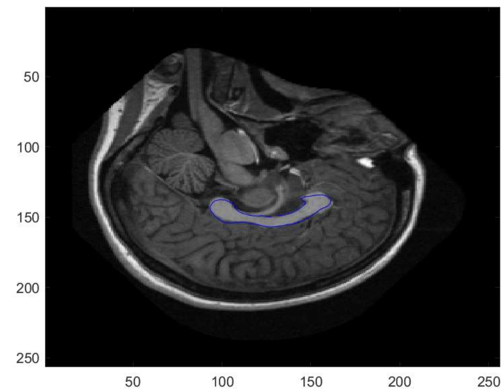
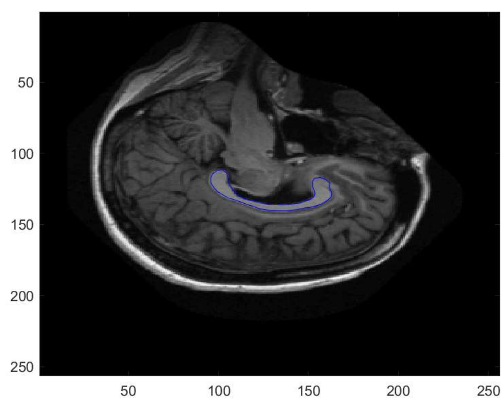


Image 5:



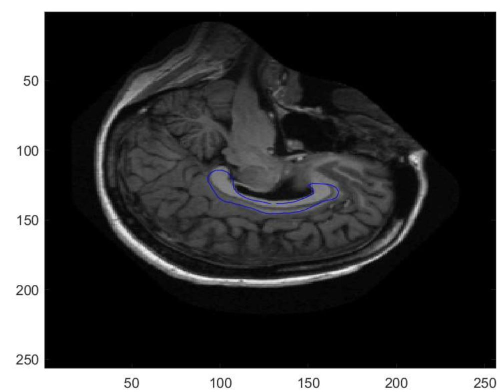
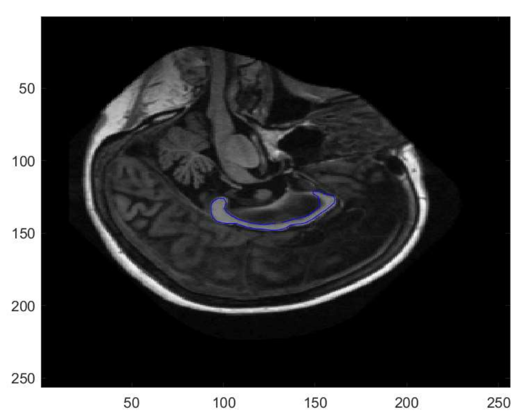


Image 6:



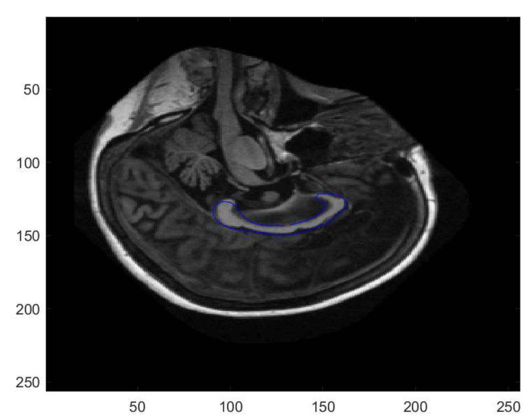


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Image 7:

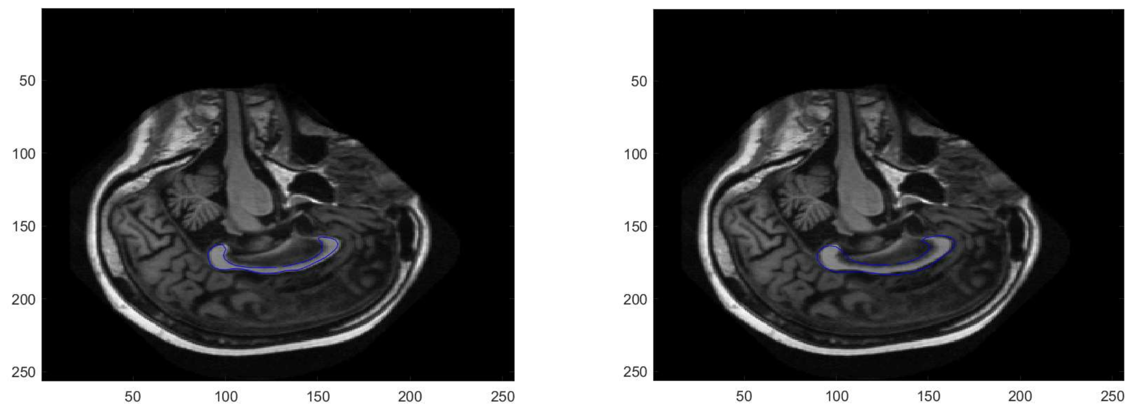
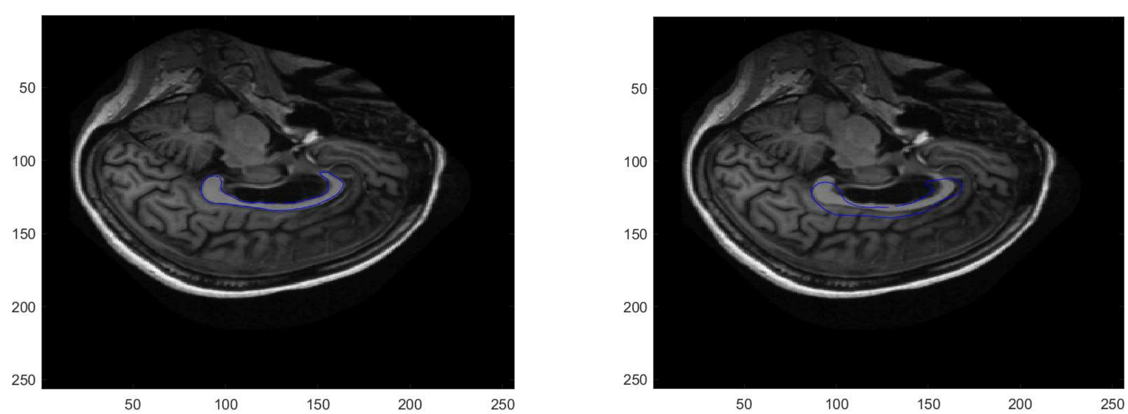


Image 8:



As we can see the applying ASM still maintains a nice image and in some cases highlights the desired area better. Note that if the algorithm were running incorrectly, the images the were resulting would not have converged nicely around the images that we started with. Experiments were done trying to start with the mean image and attempting to start with a more general outline, but none were found to converge very well at all. Regardless, the ASM is working properly.

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Part 3:

a. Given a we can relate it to w in the following way:

$$w = u_g + [u_1 \quad \dots \quad u_{m_a}] * a$$

b. Given b we can relate it to I in the following way:

$$I = u_I + [v_1 \quad \dots \quad v_{m_b}] * b$$

c. Given c we can relate it to a in the following way:

$$\begin{bmatrix} a \\ b \end{bmatrix} = [h_1 \quad \dots \quad h_{m_c}] * c$$

d. Looking at the relationship between ΔI and Δc are related by the following matrix multiplication

$$\Delta c = \begin{bmatrix} t_{1,1} & t_{1,N} \\ t_{m_c,1} & t_{m_c,N} \end{bmatrix} * \Delta I$$

Since ΔI is a N x 1 matrix and Δc m_c x 1 matrix, the parameter matrix to map ΔI to Δc must be a m_c x N matrix. t are the parameters that we are tuning in order to relate intensity to map.

e. Since c will be remapped to c + Δc we can label c + Δc as c_{new} and find a_{new} and b_{new} in the following relationship:

$$c_{new} = (c + \Delta c)$$

From this we can extrapolate a_{new} and b_{new} in the following way:

$$\begin{bmatrix} a_{new} \\ b_{new} \end{bmatrix} = c_{new}$$

This gives a way to generate a_{new} and b_{new} from the change we observe in c. This can be used in order to find b_{new}.

f. The displacement from w to w + Δw will be computed from the modified values of the eigenmode coefficients for u_i here we are calling these a. So a_{new} from part e will be used to calculate this change. Equation for w_{new} is given below:

$$w_{new} = u_g + [u_1 \quad \dots \quad u_{m_a}] * a_{new}$$

From this we can infer Δw in the following way:

$$\Delta w = w_{new} - w$$

This will be applied to the reference image.

g. The intensity change from I̲ to ΔI̲ will be computed using the eigenvectors v_i so there corresponding eigenmodes will be what we are calling b_{new}. We can calculate a new I in the following way:

$$I_{new} = u_l + \begin{bmatrix} v_1 & \cdots & v_{m_b} \end{bmatrix} * b_{new}$$

From this we can infer ΔI̲ in the following way:

$$\Delta I = I_{new} - I$$

This will be applied to the reference image as well.

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Appendix:

All code located at the address below:

https://github.com/SamuelDGeorge/Comp_775_Assignment_2