Semester Project – segmenting foods

ECE 6310

By: James Nguyen

Data

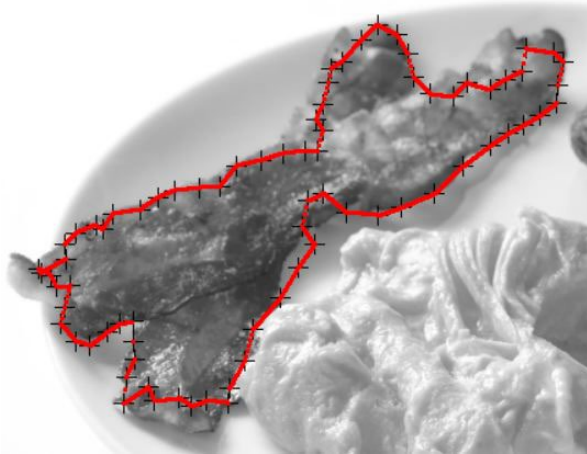**Image #1: bacon-eggs-toast.pnm**

Figure 1: Rubber Band Contour for Bacon

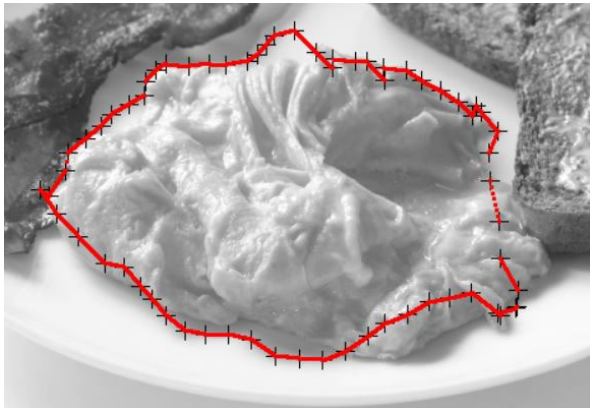*Figure 2: Balloon Contour for Bacon*

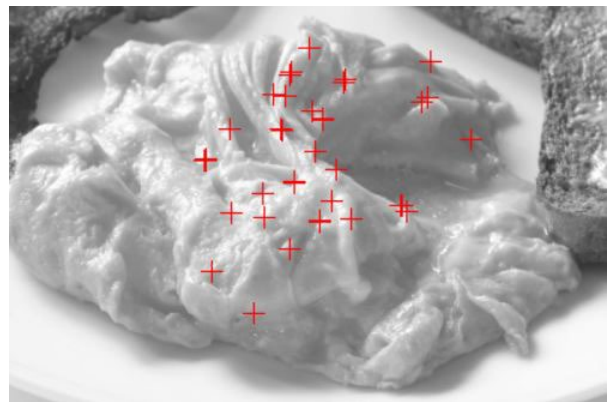*Figure 3: Rubber Band Contour for Eggs*
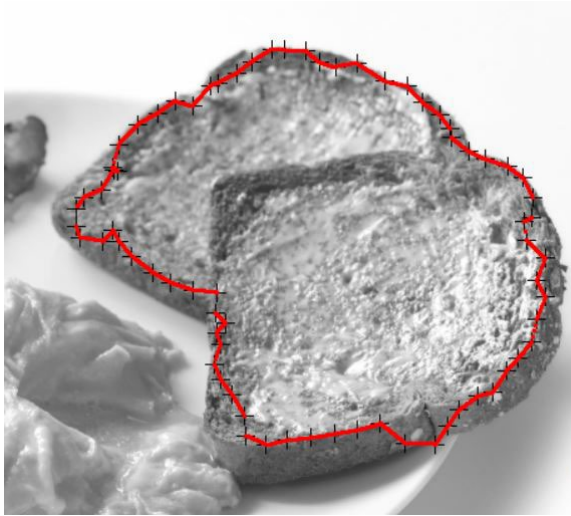

Figure 4: Balloon Contour for Eggs

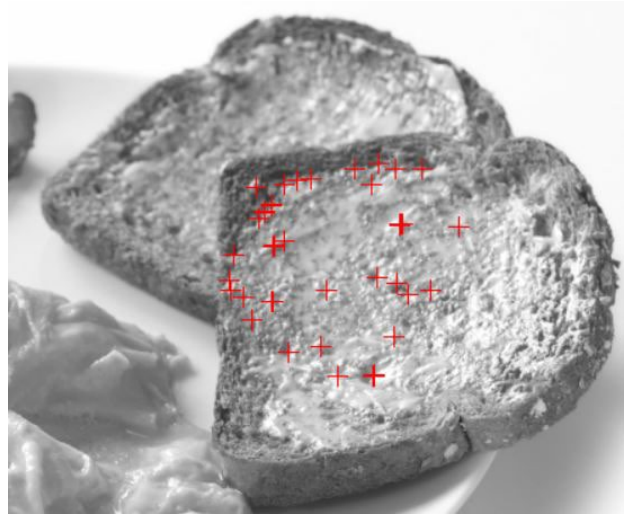*Figure 5: Rubber Band Contour for Toast*

Figure 6: Balloon Contour for Toast
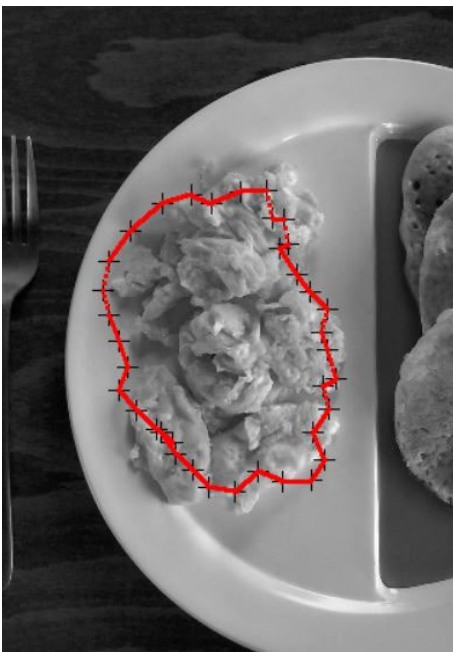
Image #2: eggs-pancake-milk.pnm

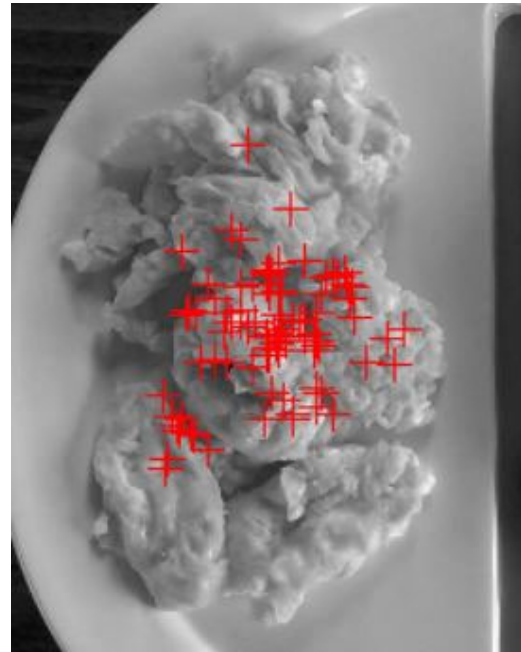*Figure 7: Rubber Band Contour for Eggs*

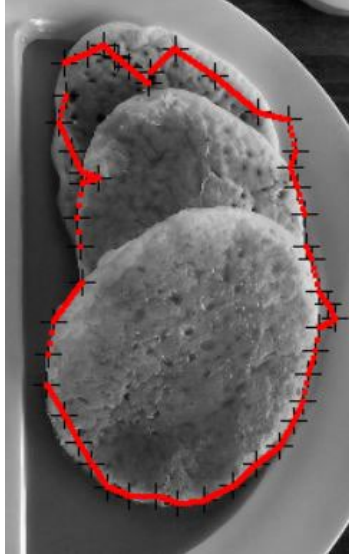*Figure 8: Balloon Contour for Eggs*

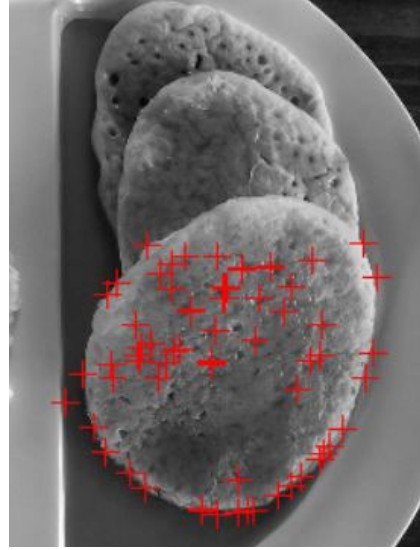*Figure 9: Rubber Band Contour for Pancakes*

Figure 10: Balloon Contour for Pancakes
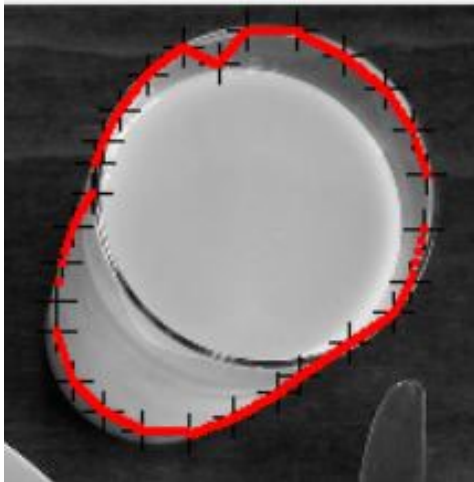
Figure 11: Rubber Band Contour for Milk
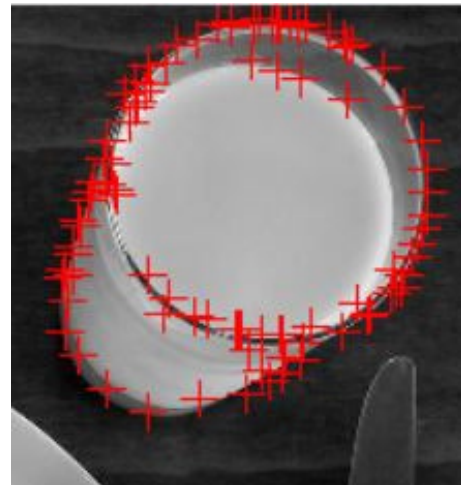
Figure 12: Balloon Contour for Milk

Image #3: hushpuppies-biscuits.pnm

Figure 13: Rubber Band Contour for Hushpuppies

Figure 14: Balloon Contour for Hushpuppies
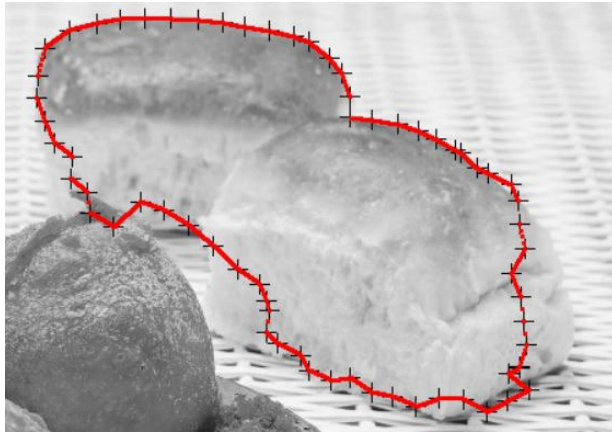
Figure 15: Rubber Band Contour for Biscuits
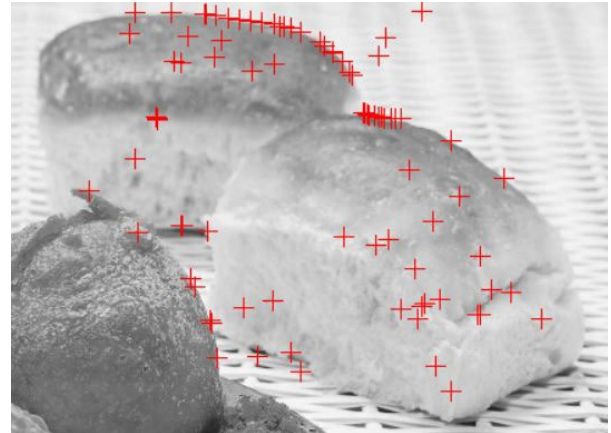
Figure 16: Balloon Contour for Biscuits

Image #4: fish-lemon-rice-greens.pnm

Figure 17: Rubber Band Contour for Fish

Figure 18: Balloon Contour for Fish

Figure 19: Rubber Band Contour for Lemon

Figure 20: Balloon Contour for Lemon

Figure 21: Rubber Band Contour for Rice

Figure 22: Balloon Contour for Rice

Figure 23: Rubber Band Contour for Greens

Figure 24: Balloon Contour for Greens

Image #5: macaroni-kale.pnm

Figure 25: Rubber Band Contour for Macaroni

Figure 26: Balloon Contour for Macaroni

Figure 27: Rubber Band Contour for Kale

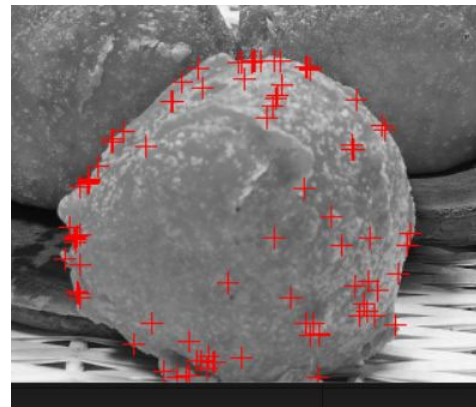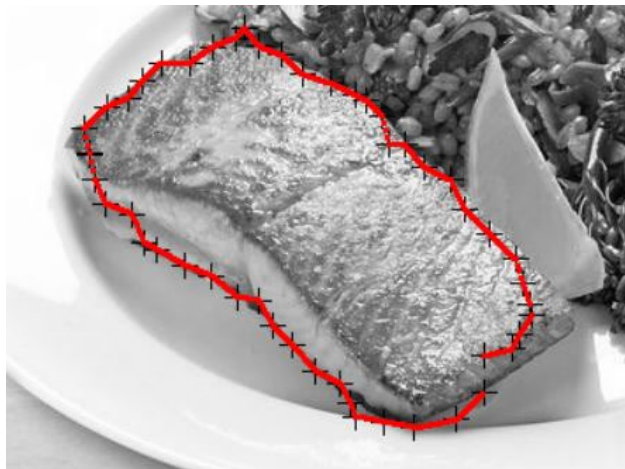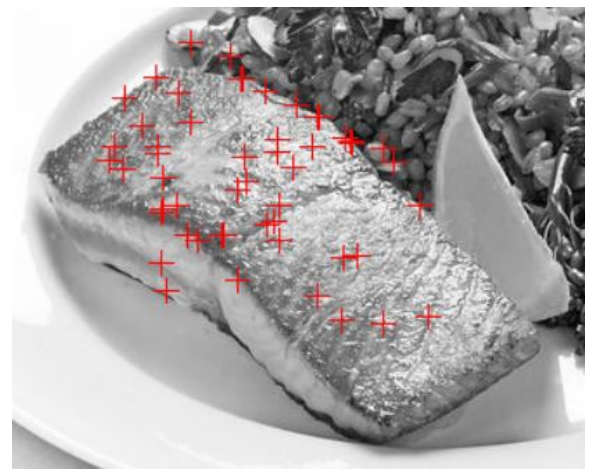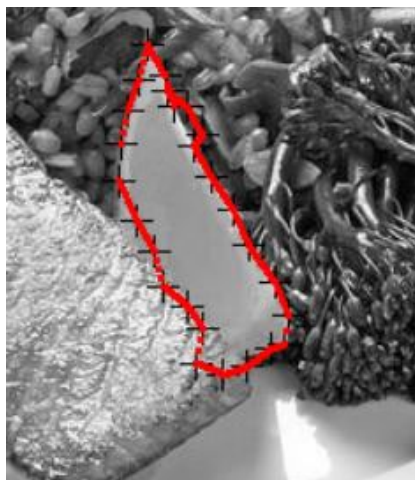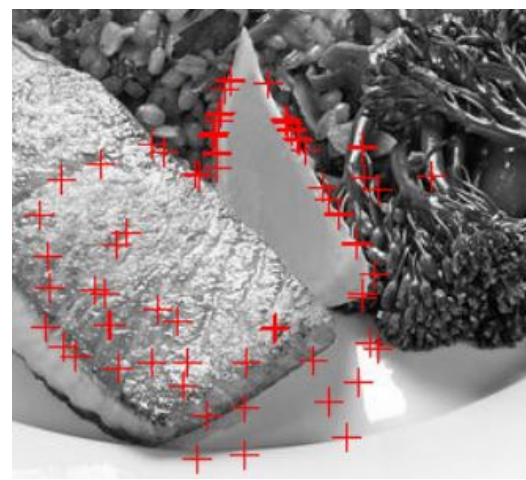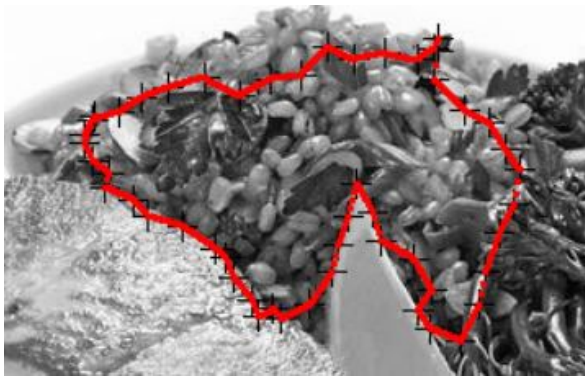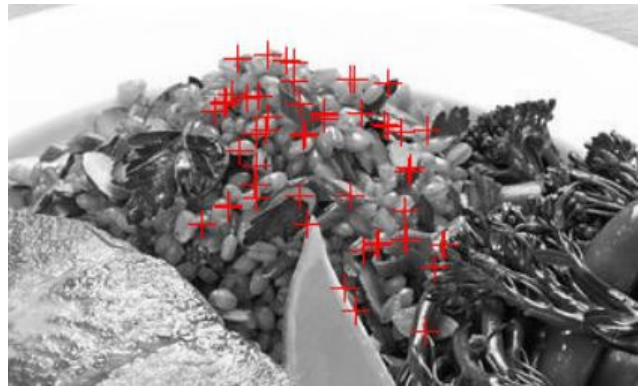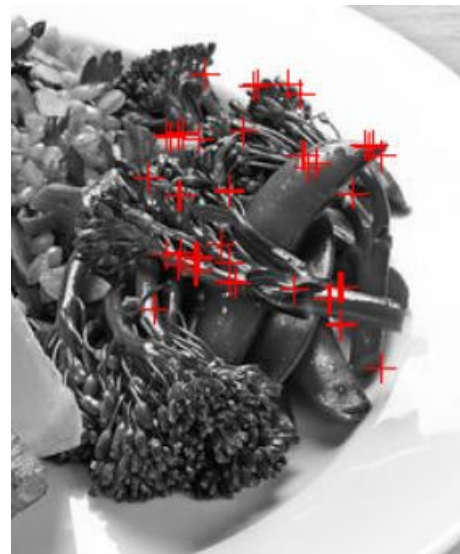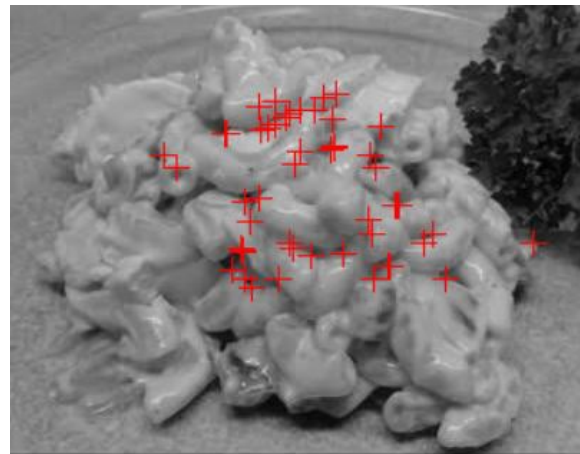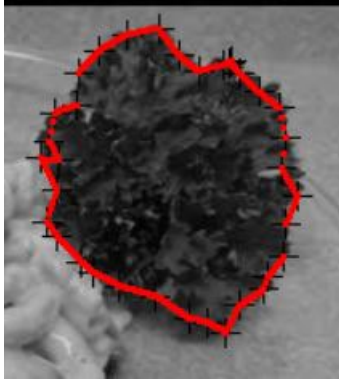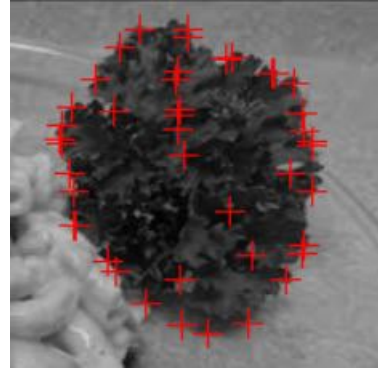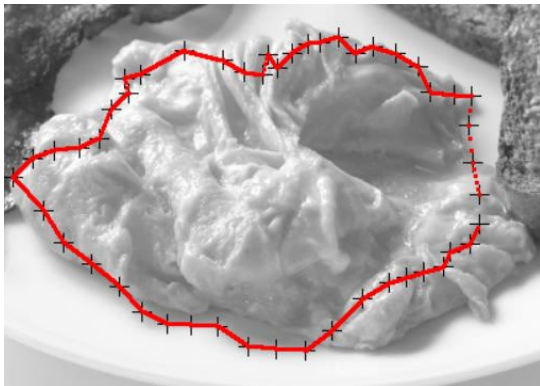*Figure 28: Balloon Contour for Kale*

Figure 29: Rubber Band Contour before Adjustment
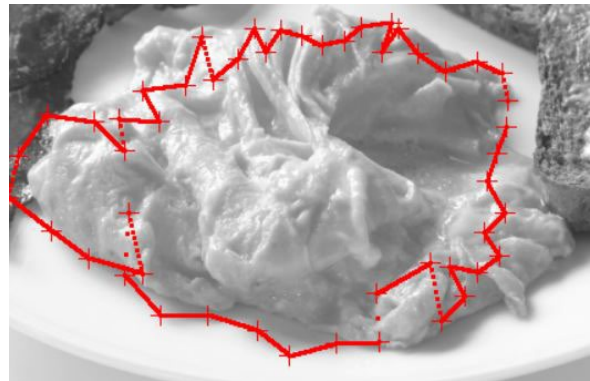
Figure 30: After Adjustment applied to Right Corner

Results and Discussion

Overall, the results of this project are positive but mixed. The rubber band contours worked out well while the balloon contour struggled for many objects especially ones with inconsistent textures. The code for the contour initialized after moving grabbing a point struggled to make a large difference.

The rubber band contour was implemented with two internal energies and two external energies. The first internal energy was based on the distance between the points while the second was based on the variance of the distance between the points. The first external energy was based on the strength of the edge while the second was based on the variance of the colors. The edges in the images were strengthened by using a sharpened version of the images. The results are quite good due to creating strong edges and having the contour gravitate towards them. The outline of each of the food items can be found with good accuracy when looking at most of the figures. Some figures like Figure 5, Figure 21, and Figure 23 show that the color energy is not working perfectly as the contour slips past the edge of the object. This problem could be improved by incorporating the variance of the RGB colors as an external energy since the external energy I used only factored in grayscale color. Also, increasing the edge strength, by sharpening or maybe even blurring the image instead could help. Using a Canny edge detector instead of a Sobel filter would also help.

The balloon contour was implemented using three internal energies and three external energies. The internal energies used were based on distance from the centroid, angle moving away from the centroid, and the distance between next and previous point. The external energies used based on edge strength, color variance, and edge strength variance. The external energies are based on a smoothed version of the image. The balloon contour's effectiveness was varied. Objects with a lot of texture or large differences in lighting or color had a harder time being captured with the balloon contour as seen in many of the figures. The balloon contour did work well on smaller objects that were already smooth or smoothed out well like in Figure 10, Figure 12, and Figure 28. I believe my biggest mistake was not using a large Gaussian blur to further reduce the texture since some of the objects could have better results. Also, adding in an internal energy to reduce curvature between points could prevent them from being randomly spread and take a shape more like the rubber band model. Also, using RGB color could also help since using greyscale color doesn't differentiate as well. Implementing the internal energy that controlled the angle of the contour did work well since it allowed the contour to move out in a more circular shape instead of linear from the centroid point.

Lastly the contour with a repositioned point was functional but the results are disappointing. The contour was implemented with one internal energy and three external energies. The internal energy was based on distance between the previous and next point while the external energies were the same as the balloon contour. Even though the contour weights were different depending on iterations, this contour mostly just shuffled the points around a little and didn't hold the prior shape as well as seen in Figure 30. Adding an internal energy to manage the curvature of the contour would likely help a lot. Focusing on the internal energies would likely be the focus of improvement for this section.