

# RAE CASTER

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## Introduction

RAE CASTER is designed to aid in research by helping researchers to outline or otherwise identify individual cells in a multi image stack of high resolution gray scale scanning electron microscope scans

## Previous Work

While looking for programs to solve this problem we found 2 that showed promise for our application or adaptation; ITK Snap, and FIJI.

### ITK-Snap:

- Features:
  - Multi angle view
  - Free hand 3D segmentation brush
  - Polygon segmentation brush
  - Snake segmentation tool
  - Fast marching Segmentation
- Pros:
  - Good Base Program
  - C++
  - Polygon Tool worked well
- Cons:
  - High memory usage
  - Fast marching tool does not work well on our images
  - Snake Segmentation does not work on our images
  - Difficult to compile
  - No Stack Alignment
  - Limited supported file types

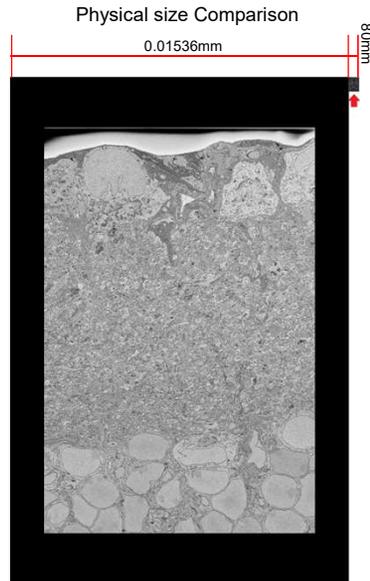


Figure A (1-1 Pixel representation)

### Thoughts

ITK snap is a good program for what it was designed for, being MIR brain images, but handles EM stacks badly, part of the reason for this is the difference in size and contrast. (Figure A) The data we work with is simply larger and more granular that ITK-snap is designed to work with

### FIJI:

- Features:
  - Free hand segmentation brush
  - Path Fill Tool
  - Fast marching Segmentation
- Pros:
  - Program works for manual segmentation
  - Stack Alignment
- Cons:
  - Fast marching tool does not work well on our images
  - Base Program difficult to change
  - Unstable
- Thoughts  
FIJI is a workable solution for manual segmentation, but is a difficult and frustrating program to attempt to add new functionality to, or change the existing functionality

## CASTER

CASTER is an environment built completely from scratch using Processing that is designed to provide a light weight environment to quickly implement and test new tools, while at the same time being a robust stand alone solution.

### Features

- Simple GUI for selecting tool
- Easily customizable code
- RAE CAST tool
- Landmark alignment
- Selection of Brushes for segmentation
- Flood Fill tool

### Pros:

- Highly Customizable code
- Light weight
- Stack Alignment
- Provides good environment for testing tools

### Cons:

- Can not import existing projects from other programs
- No existing plugins to expand functionality
- Can not open .dm3 files

### Thoughts:

CASTER provides a good base to work with, especially for rapidly testing automatic segmentation methods and shows promise of being a quality stand alone system

## RAE CAST

RAE CAST is currently a brush tool that measures the gradient along a set of rays to attempt to dynamically adjust the brush to fit against a membrane. This works in 2 steps.

1. A ring of rays is projected from a point (Figure 1), the ray will stop the first time it encounters a high gradient difference, once it does, it will mark all pixels along the ray to the end point (Figure 2).
2. After the initial rays are marked a smoothing algorithm removes any isolated thin lines and fills in small valleys (Figure 3).

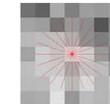


Figure 1

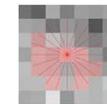


Figure 2

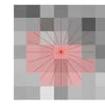


Figure 3

## Future Work

With further development we should be able to add more functionality to this CASTER and make it a fully functional tool for segmentation of cells in electron microscope scans. We plan to add more automation to decrease the amount of human effort needed to trace images

## Conclusion

- Current programs insufficient for our needs
- A purpose-built program is needed to solve our problem



Ray  
Analysis  
Estimation

Computer  
Assisted  
Segmentation  
Tool

Computer  
Assisted  
Segmentation  
Tool  
Environment  
Revisit