Annotation of Microtubule and Membranes in Cell Tomography Images.

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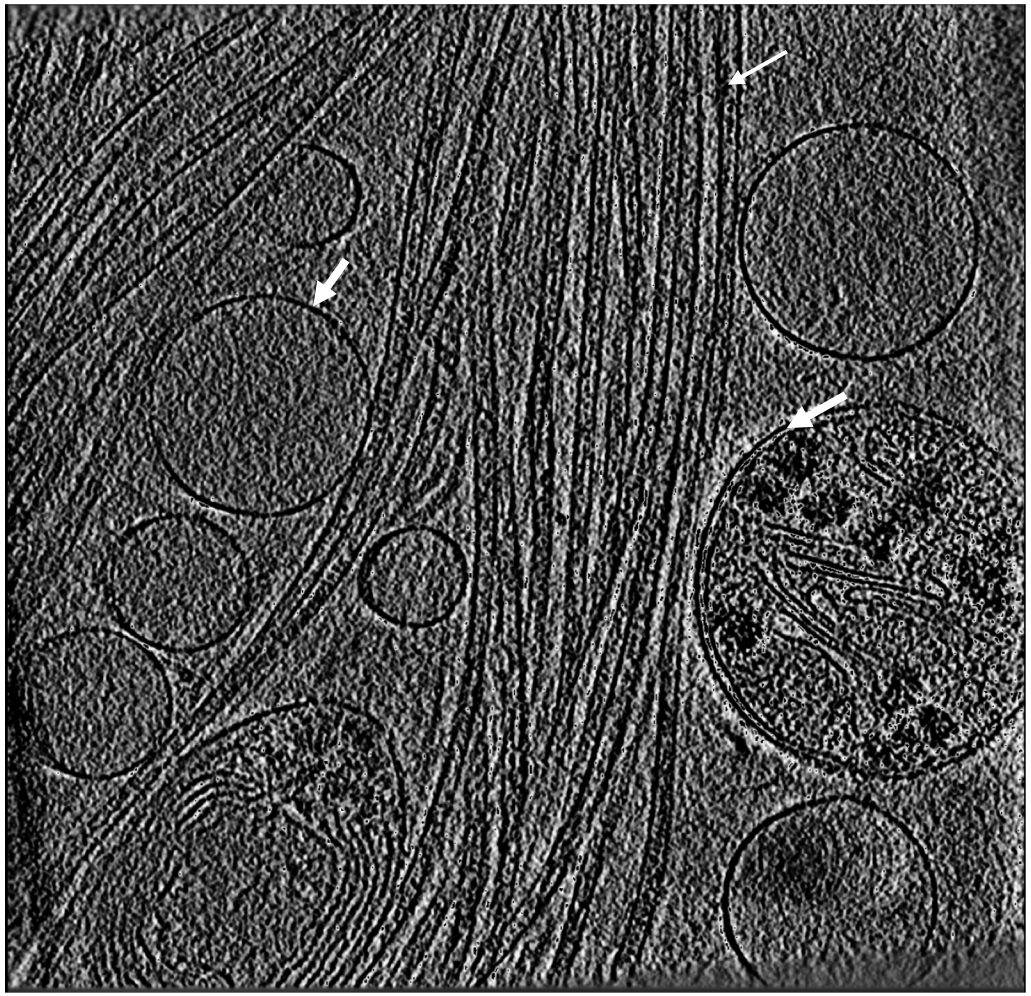
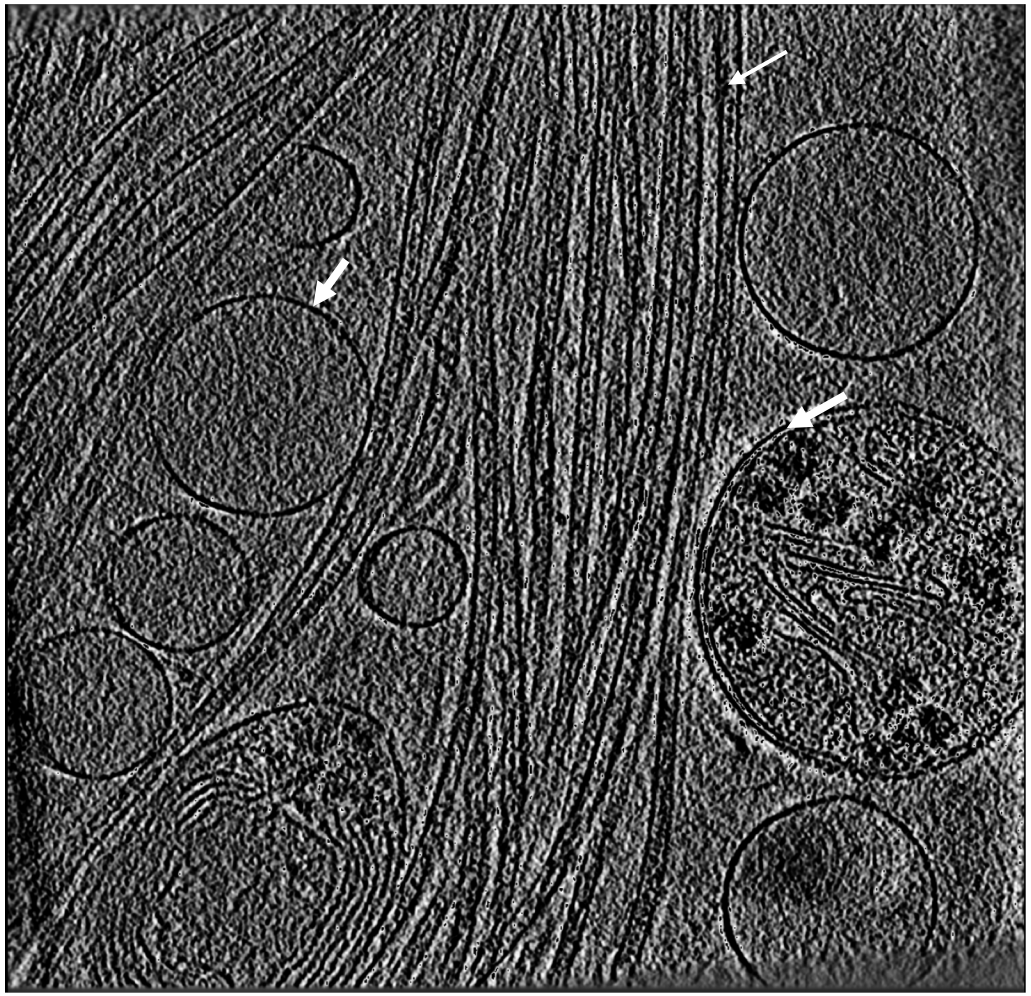
Motivation



Manual annotation of microtubules and membranes in cell tomograms is slow. In this work, I explore to segment microtubule and membranes by eccentricity difference and separately label these two features. By this work, I hope to achieve the algorithm for faster feature annotation of cell tomography.

Goal and algorithms



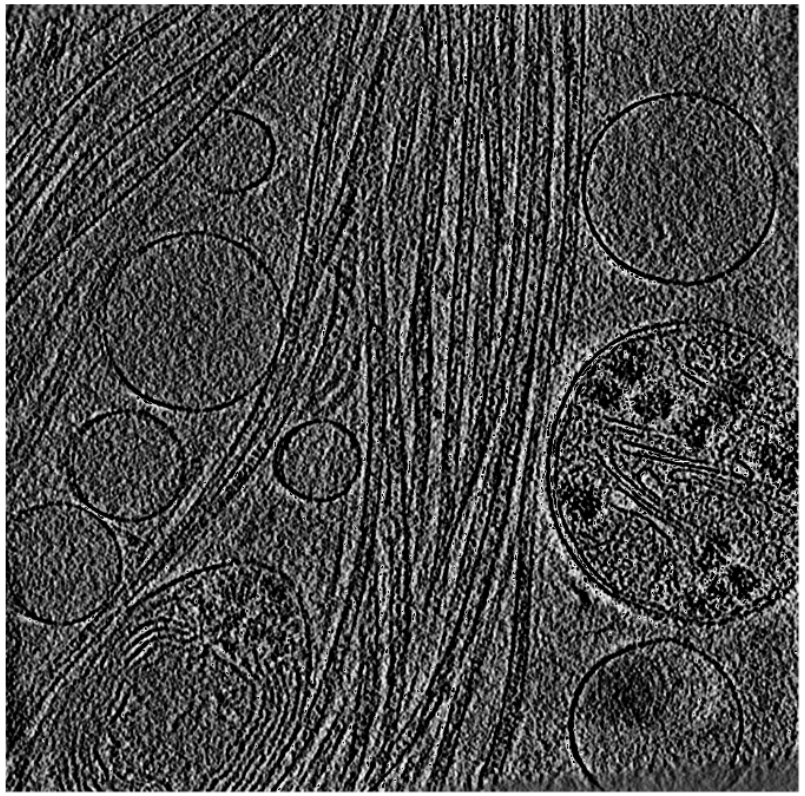
Goal: Recognize microtubule and membrane in the image and label them in different colors.

Algorithms

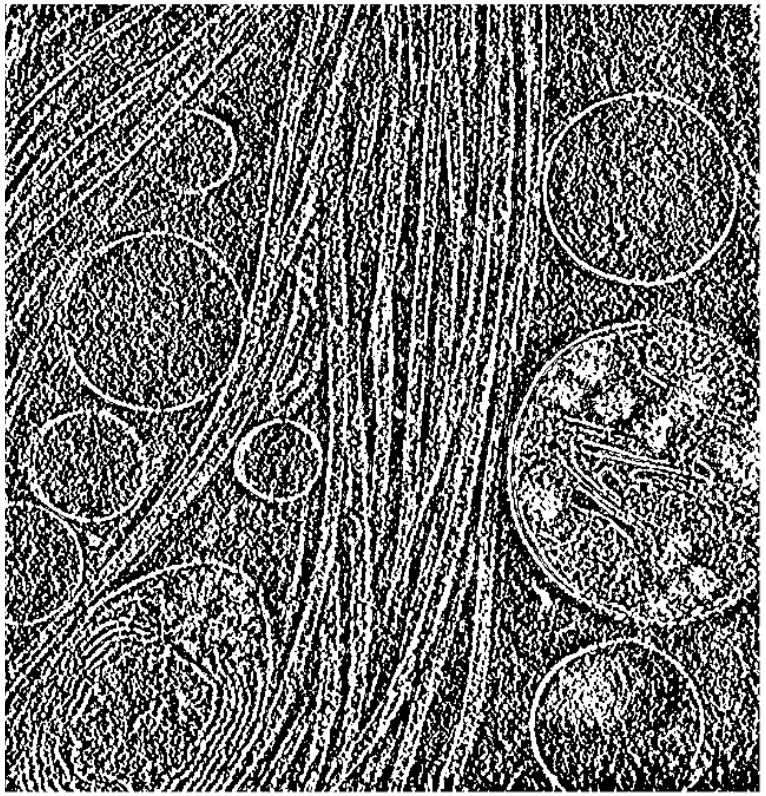
1. Preprocess image to get rid of unwanted features. These features are usually small dots. The method includes inverting image, binarizing image with thresholding, image dilation followed small region removal.
2. In preprocessed images, apply polynomial curve fitting to each region.
3. Based on the eccentricity of lines and curves, classify and label them as microtubule or membrane.
4. Evaluate for detection accuracy.

Approaches

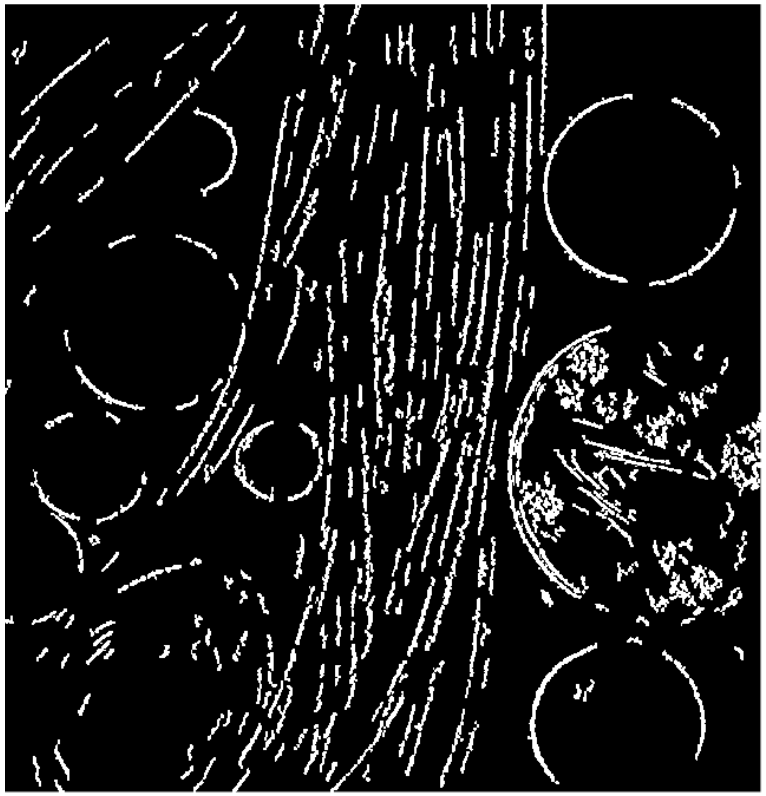
Raw Image



Invert and Binarization

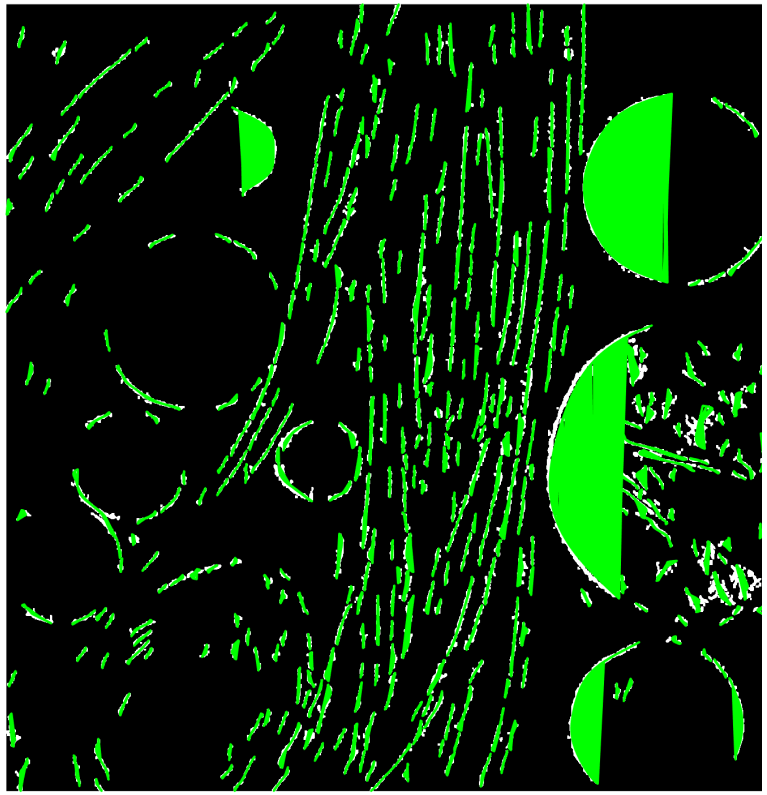


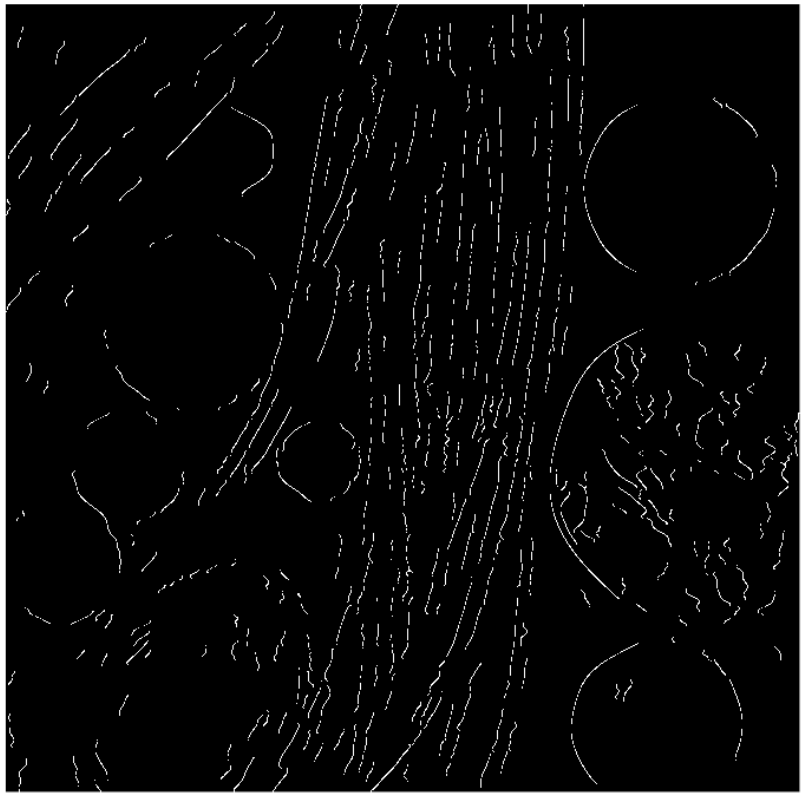
Small Objects Removal



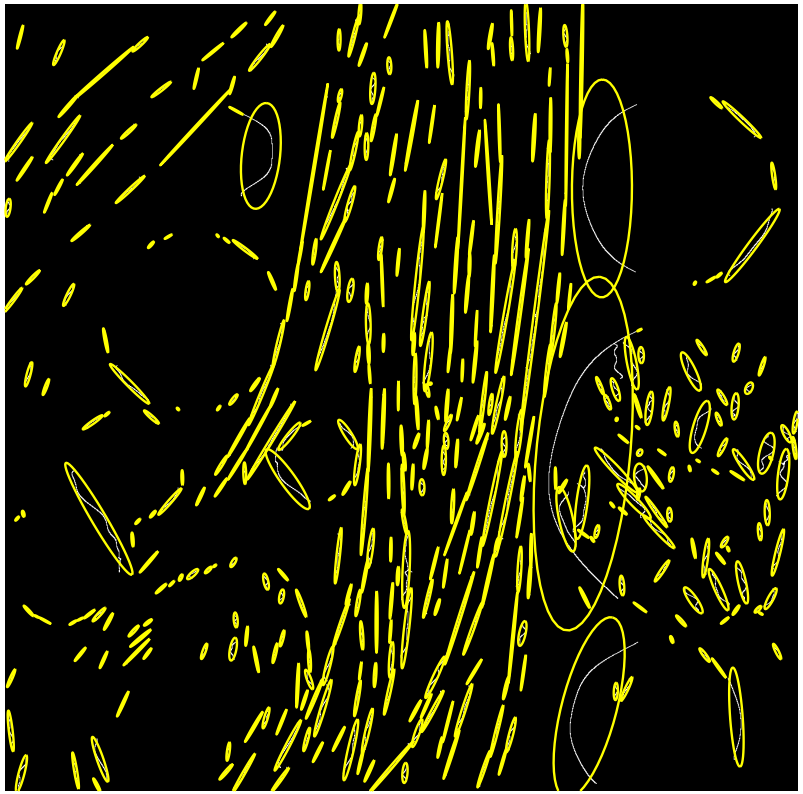
Approaches

Polynomial Curve Fitting



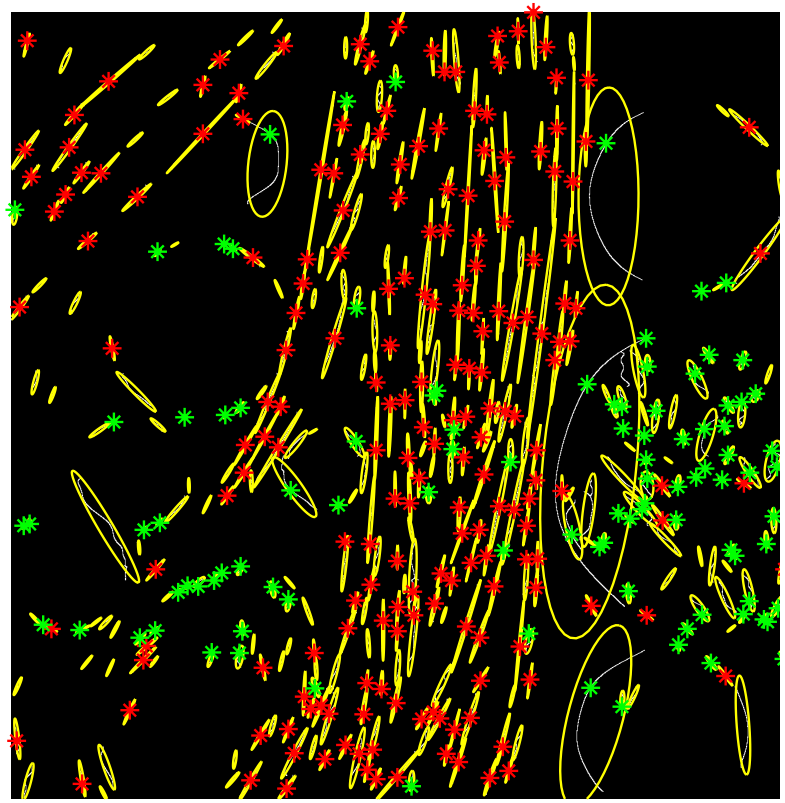


Eccentricity

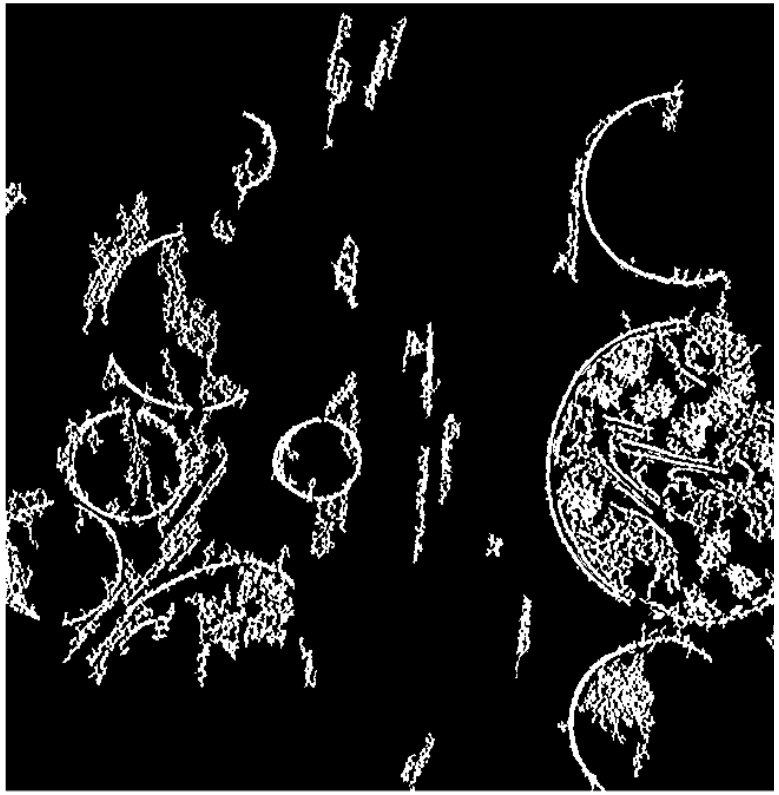


Approaches

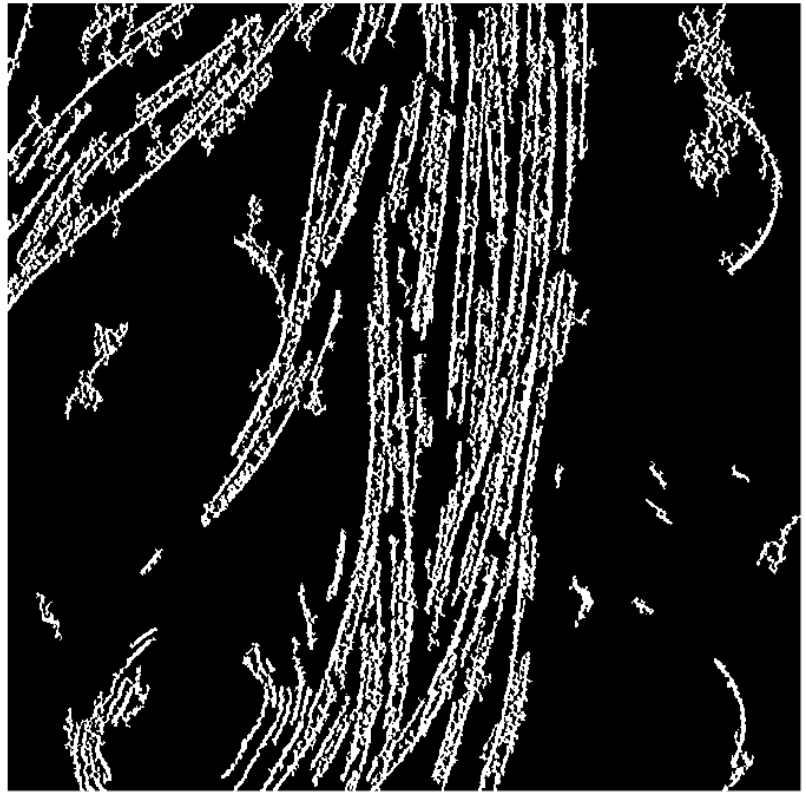
Seeds of each feature



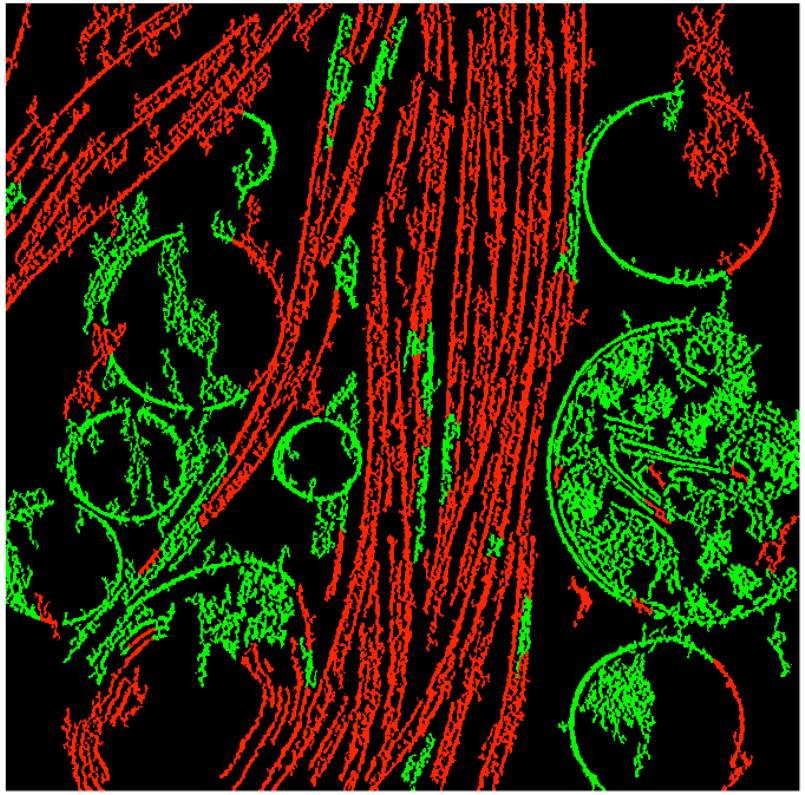
Region Grow: Membrane

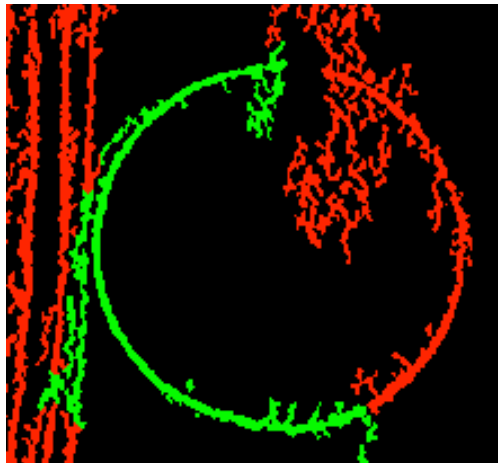


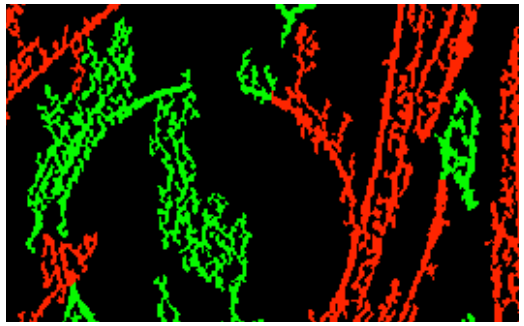
Region Grow: Microtubule

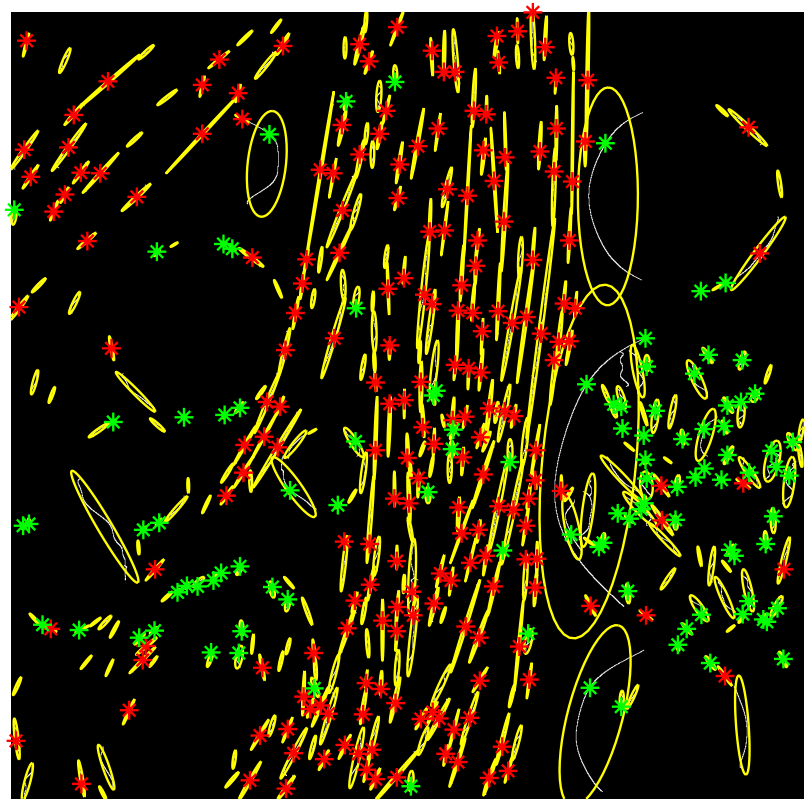


Result and discussion









Final segmentation result

Result and discussion

- Challenge in feature classification
  - Discontinuity within features.
    - Trace pixels belong to certain feature.
  - Continuity between features.
    - Include non-feature pixels.
- Thresholds to adjust.
  - Binarization.
  - Small region removal.
  - Eccentricity threshold for each feature.

Next step

- User interface
  - Extract features locally.
    - Choice of degree for polynomial curve fit.
    - Minimize misclassification due to region growing.