Astrocyte Segmentation and Classification ImageJ Plugin

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Abstract:

Image segmentation is a complex area of work that, when perfected, could create a plethora of innovation and discoveries. Our current research focuses on using image segmentation to extract data of astrocyte cells, the most abundant glial cells found within the brain.

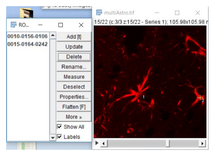
Introduction:

The astrocyte data we are receiving comes in multidimensional images, so to work with this data we are using ImageJ, an open source image processing program. We were given an existing plugin for this program that attempted to gather data about an astrocyte in these multidimensional images. It failed in working with multiple images within a single image, and was very unstable; thus making it unusable for any type of analysis on these astrocytes.

The Process:

Preprocessing:

The image is scaled to have equal dimension (height, length, width), converted to 8-bit to allow other plugins to perform on the image, the Connected Threshold Grower is used to segment the image, and holes within astrocytes are filled. Holes may occur due to microscopic imaging errors. This leaves us with a binary image of the astrocyte.



(Figure 1)

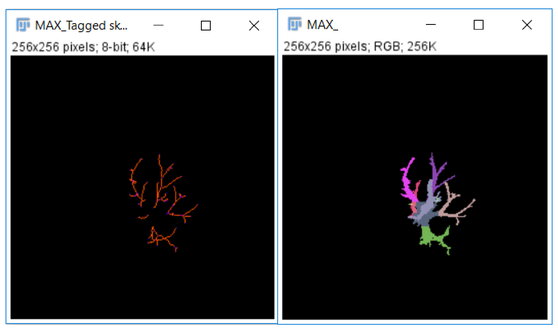
Astrocyte Classification:

1. Defining The Cell Body

The cell body is defined in a complex way, and further research is being done to develop a better method. The current method finds a radius value by essentially finding the largest sphere that can be placed within the segmented astrocyte. For every sphere with this radius that can be placed inside the astrocyte, we take the center pixel and set it as a *body pixel*. For each *body pixel* we create the same sphere again, but for every pixel on the axes of the sphere we attempt to create another sphere of the same size. For every pixel within the segmented image that is within this spherical region is also set as a *body pixel*.

2. Defining The Primary Branches

This is accomplished by using the skeleton obtained from the binary segmented image and removing all pixels on the skeleton image that correspond with the cell *body pixels*.



(Figure 2) (Figure 3)

Next, we obtain *branch pixels* by taking the ends of each separated branch (shown in Figure 2) and saving them. After collecting those pixels, we iterate through all of them and segment out each branch by using another region growing method on each *branch pixel*. We classify and merge all the parts of the astrocyte together as in Figure 3. Data is then outputted to the system for further analysis.

Conclusion

Our current approach succeeds in many respects, but fails in a few areas: (1) Defining the center of the astrocyte is not accurate in all cases, (2) there are cases where some background noise can not be eliminated; therefore there can be no analysis on the astrocyte, and (3) further data needs to be extracted and stored for more thorough analysis.

These are the main areas of interest for our current research. After which, we will work on other areas of image segmentation associated with astrocyte cells.

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