TEL411 – Digital Image Processing

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Assignment 4

Due date: Sunday, December 19, 2020

Figure 1 shows two confocal microscopy images that both contain the axon of a neuron cell. The goal of this exercise is to extract these two axons. The two images are provided to you with the names "axones1.png" and "axones2.png".

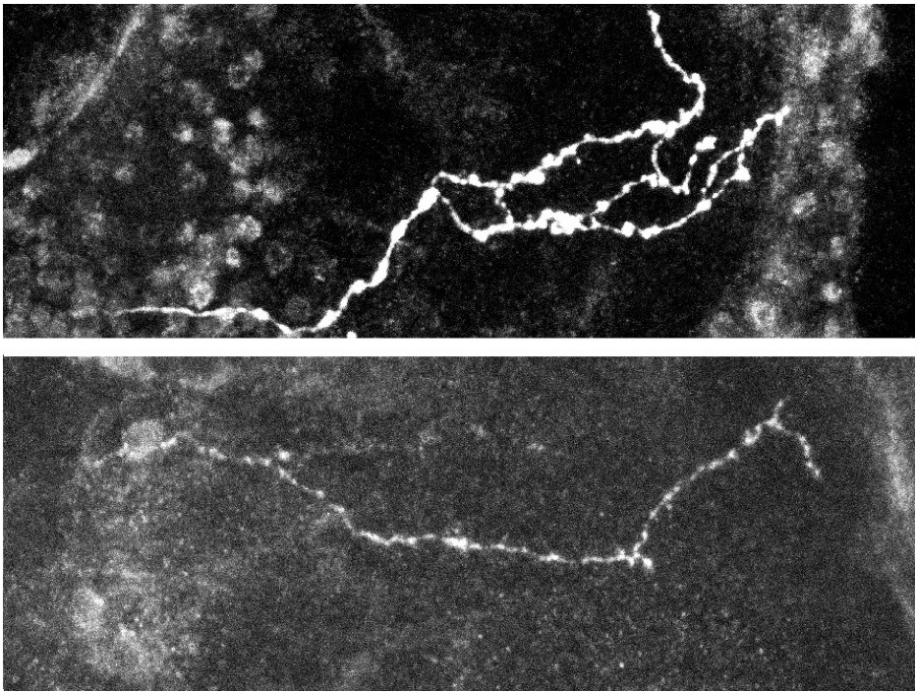

Fig. 1 –Images *axones1.png (top) and axones2.png (bottom).*

First of all, read and display your images. In order to extract the axons we need to consider the following steps:

- Image denoising: we notice that the images are degraded by a fairly significant noise. It is therefore necessary to start by eliminating this noise. Typically, this is done by filtering. For

example, linear filtering with a Gaussian or averaging kernel, nonlinear filtering of the median type or sequential filtering **alternating openings and closings.** You can test these different filtering methods in order to select the one that you think as the most appropriate.

- Enhancement of linear structures: can be carried out by calculating the **morphological gradient** or by carrying out a filtering by an adapted kernel (Prewitt, Sobel ...).

- Binarization: a threshold can be determined by **the Otsu method** (have a look at the graythresh() function). Also remember to eliminate (as far as possible) small unwanted connected components and to fill in the holes.

- Skeletalization: this step consists in keeping only the "central lines" of the related components. You will be able to watch how the Matlab bwmorph() function works and use it.

- Connection of the skeleton: finally, you have to try to fill the holes in the skeleton as much as possible and eliminate the small pieces of skeleton that may remain in the background. Combine different features of bwmorph() to achieve a result as shown in Figure 2 or alternatively use the imfill() function.

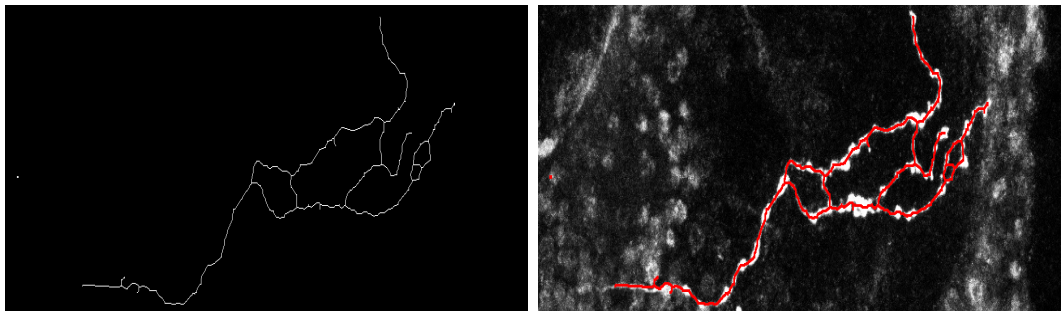

Fig. 2 –Images *axones1.png (top) and axones2.png (bottom).*

Hint

Don’t hesitate to use MATLAB’s functions for morphological processing (imopen(), imclose(), imdilate(), imerode(), imtophat(), graythresh(), imfill(), etc.) and the command “help” in order to better understand how these functions work.

What to turn in

You should turn in both your code and a report. Justify your choices and briefly describe how the functions you have decided to use work. Make sure you illustrate the outcome at each step and of course the final results as close as possible to Fig. 2 for both the input images. Please name your file as “lab4_Omada_#” where # the number of your team.

Good Luck!