Cell classification based on Pixel Intensities
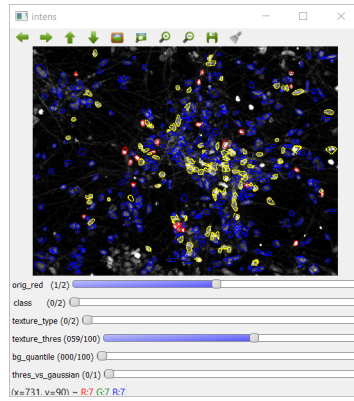
For the final classification of the cells, a gaussian mixture model is applied and gray level co-occurance matrix features are computed.

To start the applcation, you have to provide the result directory of the segmentation.

The main GUI looks like this:

Main GUI of the cell classification in the red channel

In this example, the classification image is shown. Cells marked red are background or invalid (by texture classification), blue is low expressure and yellow high expressure.

Those are the controls:

1. orig_* : switch between original image, classified image and equalized image

2. class : by clicking into a cell, the class can be changed manually which are:

    (a) 0 : background/invalid
    (b) 1 : low expressure
    (c) 2 : high expressure

3. texture_type : type of gray level co-occurance matrix texture feature which is:

   (a) 0 : homogeneity
   (b) 1 : entropy
   (c) 2 : energy

4. texture_thres : threshold for texture feature to sort out cells by texture features.

5. bg_quantile : quantile of intensities for background pixels in percent.

6. thres_vs_gaussian : switches between a fixed threshold or gaussian distribution for background detection. If threshold (value 0) is used, the bg_quantile percentage determines a threshold based on the pixel quantile. Otherwise, background is determined by a gaussian.

Also, there is a box called select, which is used to select an image.

The gaussian mixture model is computed with Scikit-Learn. The result for the pixel values are shown in a matplotlib graph, here an example for the red channel:
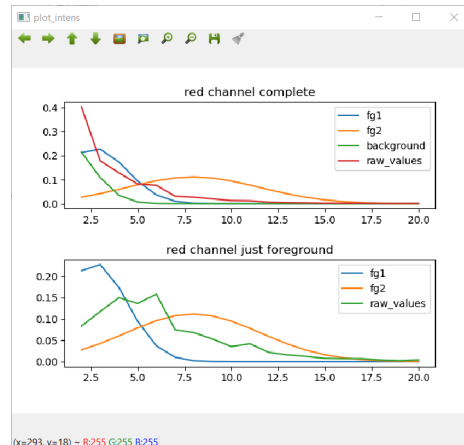
Plots for the Gaussian distributions for the red channel

Here, fg1 and fg2 and background in the first plot are the three gaussians computed for the whole image and are used to classify low expressure, high expressure and background. Raw values are the frequency of pixel intensities. In the second graph, just foreground pixel values are considered.

By pressing the key 's', the resulting images and a csv file for the current configuration are created and stored in a directory called "TIMESTAMP_classified". Per image triple, several files are created:

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1. "_classes_green" : classes marked in green channel.

2. "_classes_red" : classes marked in red channel.

3. "_ID" : all localized cells with ID number.

4. "_info" : table with cell information. Here, information about the gaussian means are given as well as combinations of low and high expressure combined in channels. Also, information as cell center, perimeter, cell area and means in both red and green channel as well as the classification result are given. The ID corresponds to the number in the "_ID" file.

5. "_scaled_green" : original green channel image intensity scaled.

6. "_scaled_red" : original red channel image intensity scaled.