Foam Image analysis script. User guide.

STEP 0:

- define the folder in which all images of the series to be analyzed are stored.

```
# path_data = (r'U:\\Uni\\PSCM Coordinator\\HDR\plots\\Foam\\data_analysis\\Image corrigées')
path_data = (r'9-10-1750/DF + DL2')
```

Path can be provided as absolute path, or relative to the folder where the script is store.

- define the time at which the foam is generated. I recommend using the time at which foaming was stopped and the the location of the rundex file generated during data reduction. The script will use this file to define the age of the foam for each image analysed.

```
t0 = '10-Dec-23 17:37:34'
t0 = dt.datetime.strptime(t0, '%d-%b-%y   %H:%M:%S')
try:
    rundex = pd.read_excel('index_234_d33_exp_9-10-1786_400000-406553.xlsx')
except:
    print('could not load excel rundex file')
```

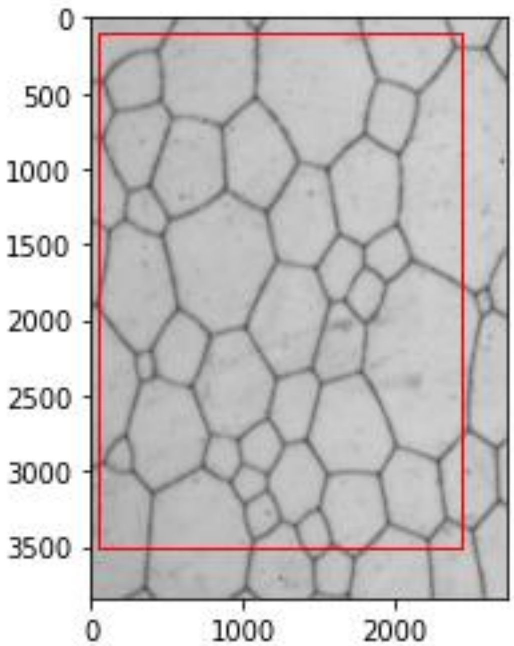
STEP 1: Define the region of interest, i.e., define the area of the image, which will be analysed by the script.

```
region_of_interest = ((100,3500),(50,-300))


define_region_of_interest = True
```

The region of interest is defined by four pixel values, y1 = 100, y2 = 3500, x1 = 50, x2 = -300. Positive number indicate the absolute pixel number, negative number indicate the pixel value from the right, or bottom border.

If **define_region_of_interest** is set as True, the following image is created, and the script is terminated.



You can see that the value of x2 = -300 corresponds to approximately 2450 pixels, given that the figure has a width of 2700 pixel. Optimize the values of the region of interest, to avoid the presence of disturbing elements: e.g., non-sharp regions in the figure, stains, the shadow of the cable, etc.…

You can check if the selected region of interest is suitable for different images, by changing the last parameter of the **plot_region_of_interest()** function.

```
if define_region_of_interest is True:
    plot_region_of_interest(path_data,region_of_interest,0)
    sys.exit()
```

Here, zero means it looks at the first file in the folder. By changing zero with other integer numbers, you can check if the region of interest suits the whole series.

Before proceeding to the analysis of the images, remember to set define_region_of_interest to False:

```
define_region_of_interest = False
```

STEP 2: Define other analysis parameters, most notably is the analysis of the Plateu Border thickness is performed.

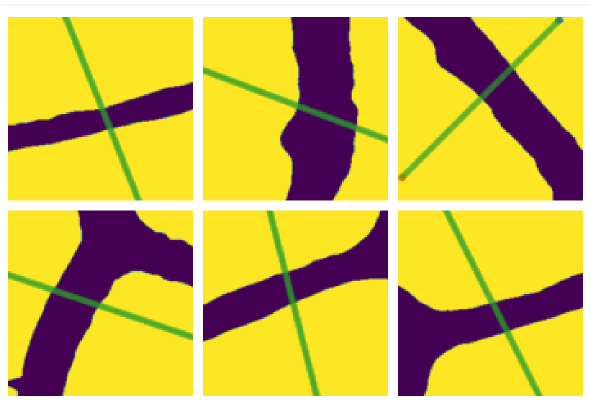
```
PB_analysis = True #Is the PB border thickness determined.
min_vol_f_for_PB = 5.0 #PB border radius will be determined for images wit
NPB_fits = 200 #Number of fits to determine the PB radius
```

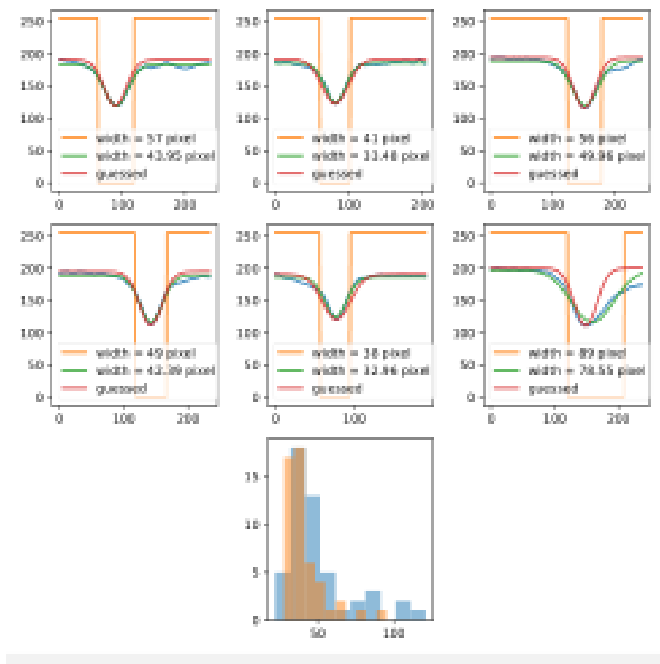
In particular, you have to define the minimum volume fraction of the foam so that the analysis is performed. If the liquid fraction exceeds this value (5% in the given example) the analysis is NOT performed. NPB_fits is the number of thickness determination attempted by the script. A too low number my result in low statistic, a too high number requires longer times. I suggest something about 100-200 number of fits.

OUTPUT: if everything runs properly, you will get an output which looks like the following.

For each image, a file_name_data_radius.txt file is generated, and it contains the values of the radii of each full bubble within the region of interest.

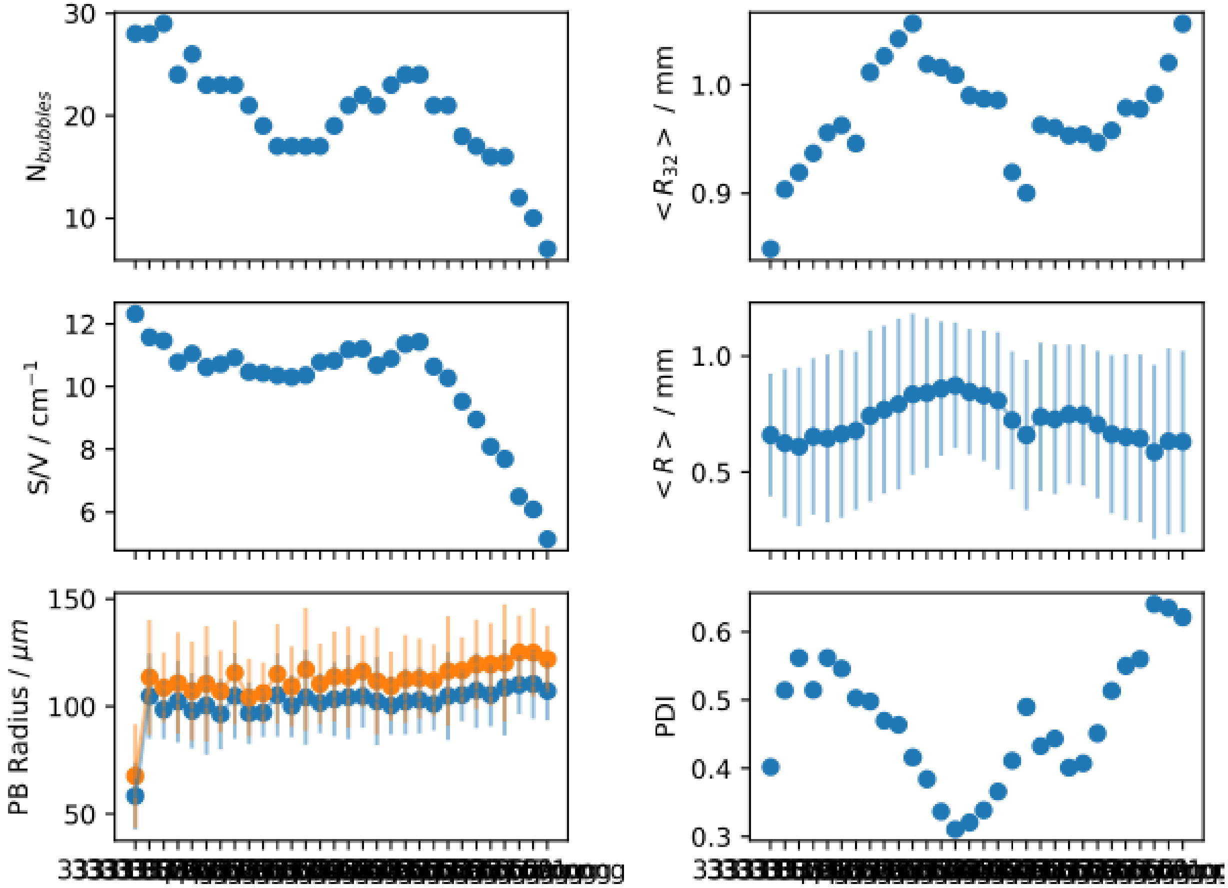
For each image, two pdf files are generated, showing the PB radius analysis. In one, it shows the cross-section which is fitted with a Gaussian curve. Ideally, this cross-section is perpendicular to the PB border (it does not work 100% of the time, but it should work for most of the time). A second pdf file is generated, showing the fit of the Gaussian (green line), to the experimental gray values of the image (blue). The values are compared to a simpler image analysis of the binary images performed previously. The histogram at the bottom shown the histogram of the values obtained from the older analysis (blue), and the new Gaussian fit approach (orange). These data serve to check that the script has worked correctly, and can, in most of the cases, be ignored.





An additional folder (bin_img) is created, where the binarized images are stored. They can be used for further analysis of simply to check that everything worked out correctly.

The script extracts from the images the number of bubbles, their size, the specific area, as well as the PB radius. The results are plotted in the file summary.pdf and stored in a mean_CSV.csv file.



In this example, not much is really happening, and most parameters are approximately constant. It is good habit to delete all images which are clearly unusable from the folder, for instance images where the foam has completely disappeared.

To avoid excessive use of memory, it might be better to run the script directly from the powershell console, and not programs like Spyder or PyCharm.