MEDICAL IMAGE PROCESSING

Master's degree in Biomedical Engineering

Liver Steatosis Challenge

The challenge aims to segment steatosis in histological liver images. Specifically, participants must segment individual steatosis vacuoles present in the images. The provided dataset consists of 510 images. Manual segmentations performed by an expert operator are provided for all images.

The challenge materials can be downloaded at the following link:

https://politoit-my.sharepoint.com/:u:/g/personal/massimo_salvi_polito_it/EZ-vlqKh-dNKkRaPMUVUqdUBcnUGr_FSNMx0CxOVburjNA?e=ZYYb7k

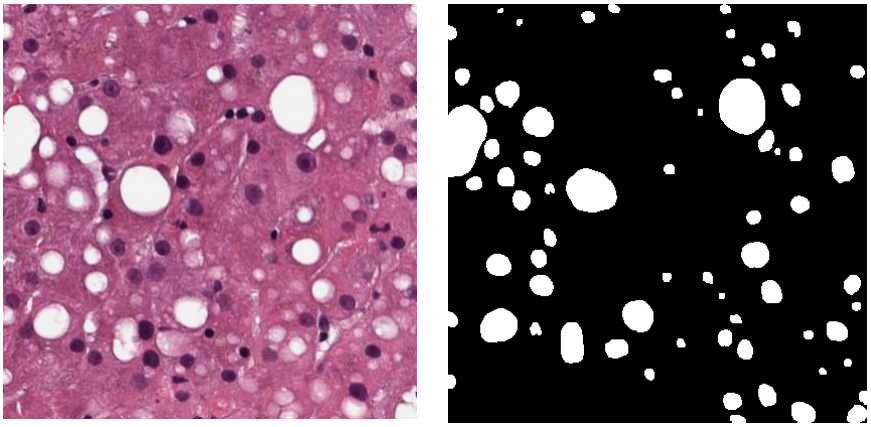

Figure *Example of a histological image and the corresponding manual segmentation.*

The images are provided in RGB, **PNG** format, and encoded in **uint8**. Manual segmentations have been exported with the same format and encoding as the images, using a binary coding that assigns value 0 to the background and value 255 to manually segmented steatosis.

Challenge Rules

Any combination of segmentation techniques covered during the course can be used, such as thresholding, region growing, deformable models, deep neural networks, etc. Any pre-processing and/or post-processing considered necessary is permitted, as long as the entire pipeline remains fully automated. It is mandatory to implement at least one pre-processing strategy to reduce color variability and at least one post-processing strategy to separate potentially merged steatosis vacuoles. Finally, remember that 6 out of 10 points for the solution quality grade are dedicated to pre-processing and post-processing methods. Final performances will be evaluated on an external Test set.

Submission Requirements

- Report (maximum 10 pages, excluding title page and bibliography) that must contain at minimum: problem introduction, detailed description of the strategy used with a possible flow-chart, presentation of obtained performance, and critical analysis of limitations. The report must also include an **ablation study**, i.e., a quantitative comparison of results obtained from the segmentation method alone (i.e. without pre- and post-processing) and those obtained after applying pre- and post-processing strategies.

- All scripts used for developing the automatic method with related functions and/or trained model.

- The testing script used to perform individual steatosis segmentation. This script must contain the pre-processing and post-processing strategies used for automatic segmentation of each image. The script must take as input the single microscopic image and output the corresponding automatic mask. These masks must have the same format as manual annotations. The test script should not save intermediate steps. Please follow the template provided in the 'mockup_submission_stu.ipynb' script. Clearly indicate path definitions within the code.

Materials should be compressed into a single ZIP/RAR folder and sent via email using a link (Google Drive, Dropbox, WeTransfer, etc.) to the challenge referee (alen.shahini@polito.it).

Evaluation metrics

As performance evaluation metrics, for each image you must calculate at least:

1. The Dice Similarity Coefficient (DSC) between the automatic mask and the manual mask for steatosis segmentation. The DSC measures the overlap between the two masks and varies between 0 (no match) and 1 (perfect match).

$$DSC(X,Y) = \frac{2|X \cap Y|}{|X| + |Y|} \quad (1)$$

   where X represents the manual mask and Y the mask obtained through automatic segmentation.

2. The absolute error in automatic and manual counting of steatosis vacuoles. The absolute difference between automatic and manual counts will be calculated to estimate automatic segmentation accuracy.

$$Count_{error} = \left|N_{steatosis(manual)} - N_{steatosis(automatic)}\right| \quad (2)$$

3. The steatosis percentage error, calculated as the absolute difference between automatic and manual steatosis percentages:

$$Steatosis_{error} = |SP_{manual} - SP_{automatic}| \quad (3)$$

   where $SP = |(Area\_steatosis) \ / \ (Area\_image)| \ x \ 100\%$

It is recommended to implement any additional metrics deemed necessary for quantifying the performance of the developed algorithm. Metric results should be expressed as mean ± standard deviation.