Type of presentation: Poster

ID-9-P-5938 Comparative evaluation of image segmentation algorithms for microscopic cross-section samples

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We present results of the project aimed at comparative evaluation of image segmentation algorithms for microscopic cross-section samples. Despite the longtime effort to develop high quality segmentation algorithms, there is no universal segmentation method available. Under these circumstances, there is a dilemma which method to choose for given particular data set. Moreover, images of microscopic samples can be of various character and quality which can negatively influence the performance of image segmentation algorithms. Thus the issue of selecting suitable method for a given set of image data becomes even more prominent. We carried out a large number of experiments with a variety of segmentation methods to evaluate the behavior of individual approaches on the testing data set. We limit our study to the microscopic images that contain the sample located in the inner part of the image, mostly not reaching to the top and bottom image borders. The data may come from an analysis of painting materials used in art restoration, which is the case of the data set used in our evaluation. They can be samples of various biological materials, such as tissues, cells, or other biological structures. The task is to label an image with either foreground or background label, where the foreground is usually the inner part of the image and the background is separated and/or removed. The background is cluttered with various debris which makes the task complicated.

The set of studied segmentation methods covers various approaches such as thresholding, region growing, clustering methods and graph-based algorithms. Their results and performance were objectively evaluated by ten representative indices used for measuring the output quality of image segmentation algorithms. The main objective was to find the best average segmentation method. The method which is comparable to the best method for particular image in case of easy to segment images (majority methods can segment this image with satisfactory results) and does not completely fail in case of worse images (where most of the methods fail). Such method was found for three studied modalities (visible and ultraviolet spectra and output of scanning electron microscope) and also the lists of segmentation methods ranked according to their performances were produced through rank aggregation process. Mean Shift algorithm (EDISON) generally performed the best and thus can be considered the best segmentation method on average for related data. We verified the findings on separate testing data set and the applicability of the evaluation results was also shown on biological data.

The results of the project were submitted to the Journal of Microscopy (John Wiley & Sons).

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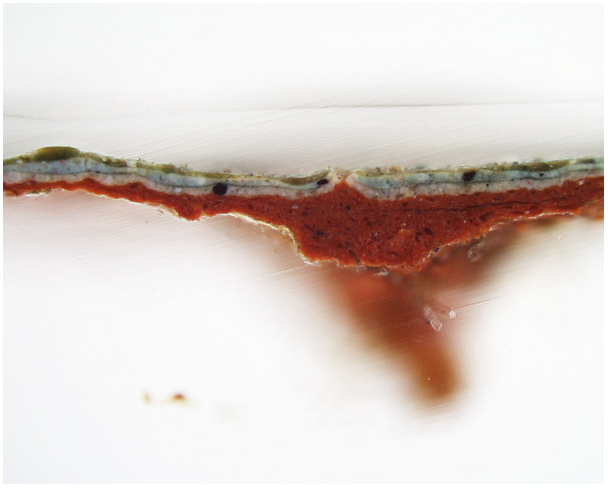

Fig. 1: The image of the cross-section sample in visible spectrum. Courtesy of ALMA laboratory.

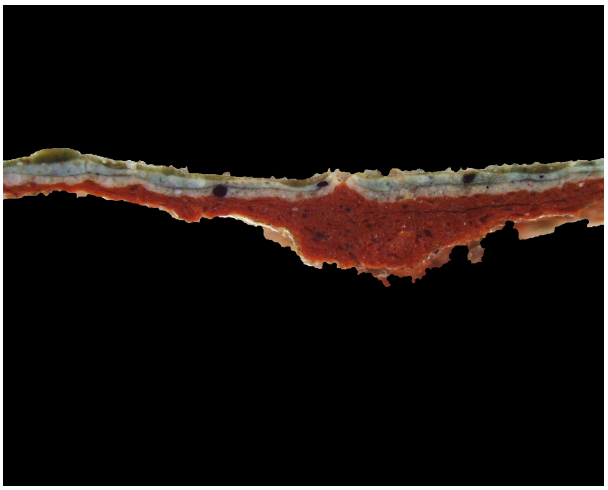

Fig. 2: The cross-section from figure 1 segmented by Mean Shift algorithm. The background is successfully removed. Courtesy of ALMA laboratory.

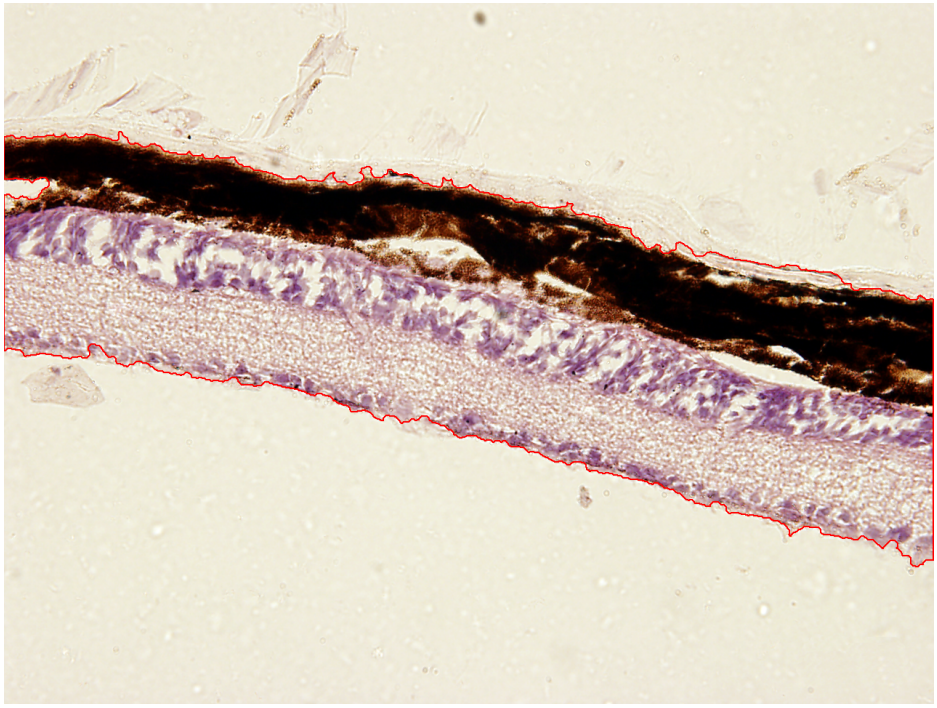

Fig. 3: Demonstration on biological image data -- mouse retina colored withhematoxylin-eosin. Boundary of segmented result by Mean Shift algorithm isdepicted by red line. Courtesy of Jan Cendelin, Faculty of Medicine in Pilsen.