TWO COMPLEMENTARY EFFICIENT METHODS TO QUANTIFY POROSITY TYPES IN DIGITAL IMAGES OF THIN SECTIONS WITH THE SOFTWARE JMICROVISION

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Introduction

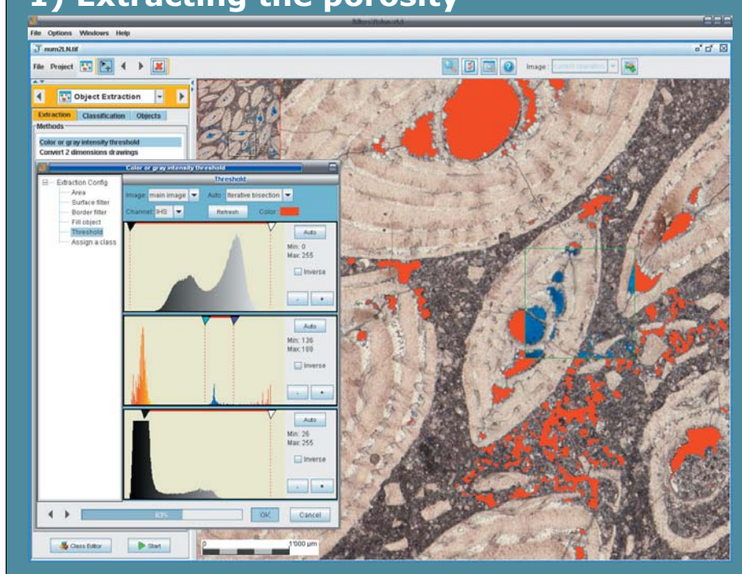
Quantitative methods for porosity estimation in digital images of thin sections are well known and have been presented in many papers. However, the quantification of porosity types is more difficult. Two different methods are proposed to estimate the porosity types with JMicroVision: 1) Semi-Automatic Classification, 2) Point Counting.

Image Acquisition Device

A digital film scanner has been preferred as image acquisition device for this study. There are two advantages in this acquisition type: 1) it enables the digitalization of the whole surface of the thin section with a high resolution, 2) there is no luminosity variation from the center to the boundary of the digitalized surface. Very large images can easily be handled with JMicroVision.

SEMI-AUTOMATIC CLASSIFICATION

1) Extracting the porosity

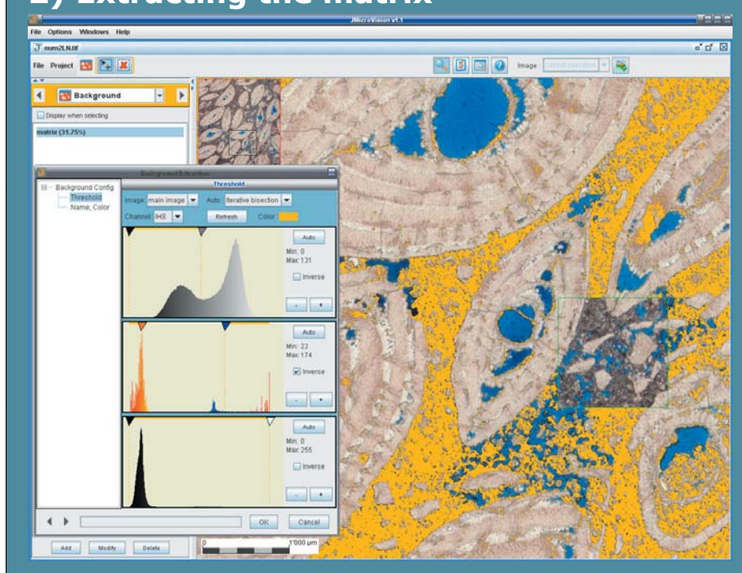


The segmentation by threshold (in *Object Extraction* tool) is used to extract the porosity.

With the IHS (Intensity Hue Saturation) mode, a range of values is selected in the hue histogram (between the arrows), which corresponds to the blue pixels of the porosity. The final selection combines the three histograms.

For checking if the selection (in red) matches properly with the porosity, the lens containing the source image with the same magnitude can be moved over the image.

2) Extracting the matrix

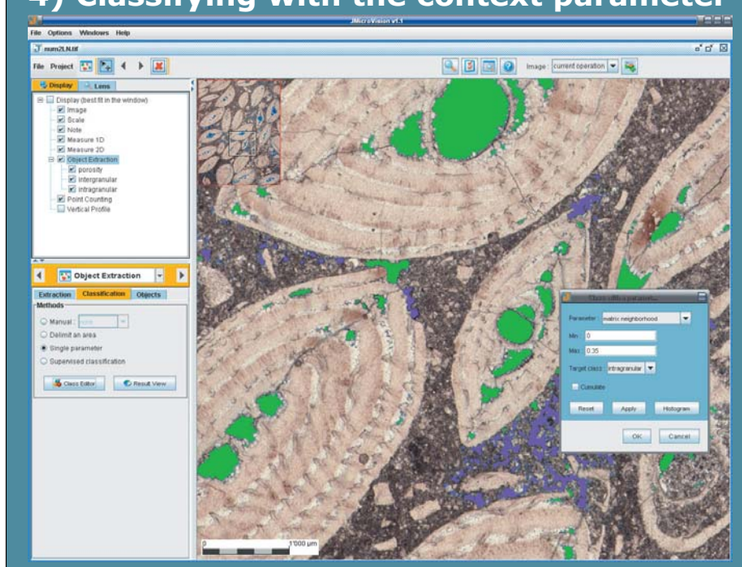


With the *Background* tool, the matrix is extracted by selecting everything except blue and yellow in the hue histogram (using the *Inverse* checkbox) and by selecting the dark values (first mode) in the intensity histogram.

3) Computing the context

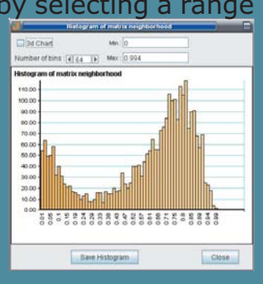
Context is an additional object parameter which describes the neighboring environment of each object (pore). In this example, the matrix represents the environment to compute.

4) Classifying with the context parameter

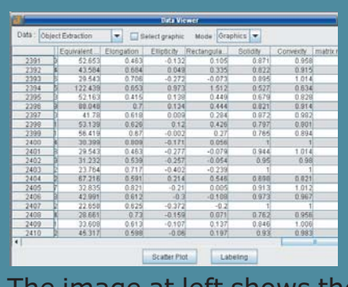


The context can be used by the *Single Parameter* classification module to differentiate the porosity types.

In the histogram we can observe two modes. The first one corresponds to pores not surrounded by much matrix. The classification is made by selecting a range of values, for instance 0 to 0.35, and by assigning the intragranular class to those pores.



5) Displaying the result

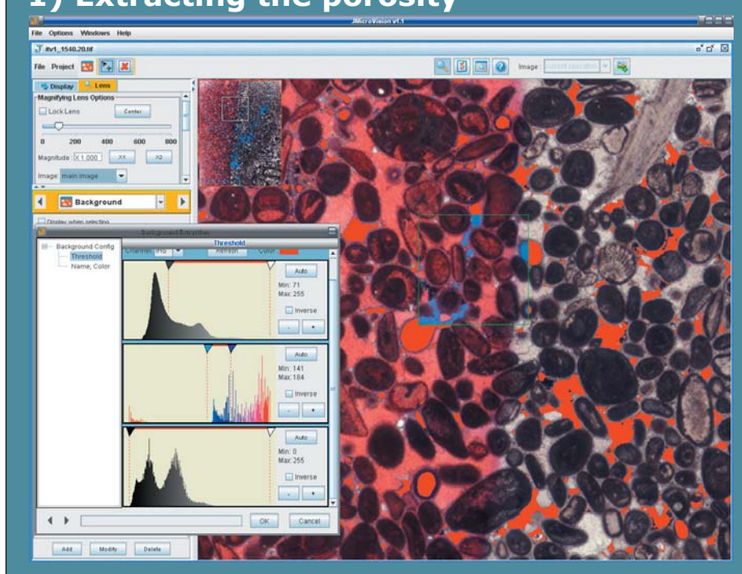


The image at left shows the result of the classification. About ten wrong classified pores have been corrected manually.

Some forty position and shape descriptors are automatically computed for each pore. These descriptors can be displayed in the *Data Viewer* and exported in a CSV file.

POINT COUNTING

1) Extracting the porosity

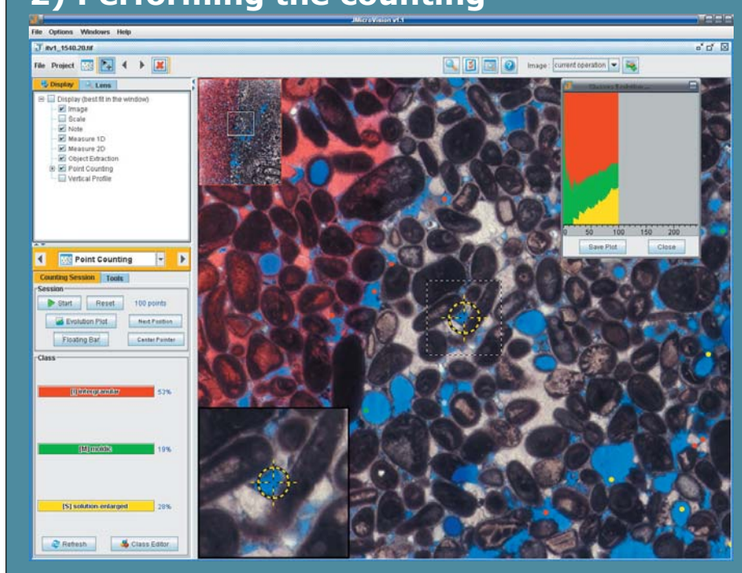


Point counting is an alternative method to quantify the porosity types stochastically when the pores cannot be classified automatically.

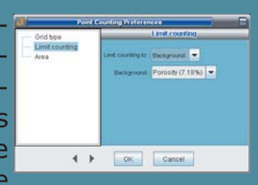
The selection of the porosity with the *Background* tool is identical to the selection with the *Object Extraction* tool. The difference is that the pores are not considered individually.

In the image at left, the blue color of the porosity is selected in the hue histogram. The dark values in the luminosity histogram, which represent the fuzzy microporosity in the oolites, are excluded.

2) Performing the counting

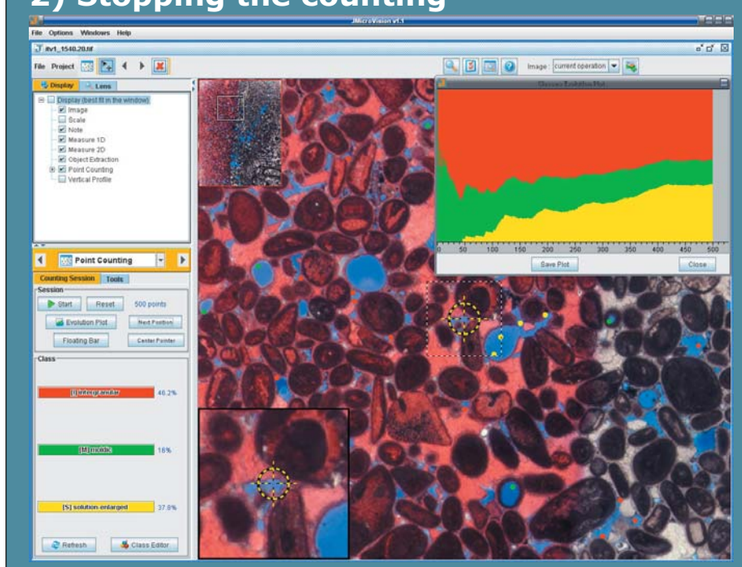


When starting the counting, a window appears and lets the user choose some options. The grid used by the counting can be either random or recursive. It is possible to limit the counting to an area and/or an object type previously extracted. In this counting, the grid is random, the area is the whole image and the object type is the porosity.



Classes can be added, removed or merged even while counting.

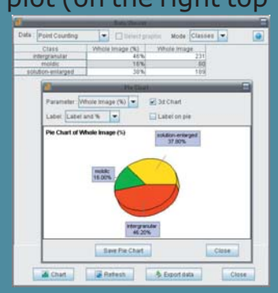
2) Stopping the counting



There are two ways of stopping the counting.

The first one is simply by fixing a limit of points (e.g. 500 points).

The second one is by observing a stochastic criterion. When the percentages are getting stable in an evolution plot (on the right top corner of the image), the counting can be stopped.



Discussion

Images acquired with a digital film scanner cannot catch micropores because the resolution of the device is not high enough. A second reason is that the thickness of the thin section is much bigger than the size of micropores (one pixel is the integration of the transmitted light through 30 microns). For catching microporosity, it is necessary to use the scanning electron microscope (backscatter electrons) as acquisition device. This method has the advantage to reflect only the information of the thin section surface.

In the counting above, the percentages start getting stable after 400 points. The overall porosity represents 7.2%, which means that 5550 points would be necessary to get the same result without limiting the counting to the porosity.