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Pre-processing of Images as a Source of Additional Information for Image of the Natural Polymer Composites

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Image processing is one of the methods of analyzing and obtaining new information. Image processing methods can be applied to any image. Image processing is used in various fields of research. Among the stages of image processing, the stage of image pre-processing is important. This stage allows increasing the efficiency of the analysis of the original image. We considered the use of pre-processing for the analysis of natural polymer composites image. In this paper, we describe the possibilities of automatic processing of natural polymer composites image.

Keywords: *pre-processing, image, information, numerical methods, natural polymer composite*

1. Introduction

Information is important for the development of modern science and technology. Information helps to understand and explore something. Information can be the basis for future decisions. At the same time, information can be open and such that it requires additional costs for its understanding.

Information has different sources. One of the sources of information is the image [1]. We can view various images: video images, x-rays, ultrasound images, infrared images and the like. One of the objects of study in the image can be of the natural polymer composites [2, 3].

Image is an image of the outside world. At the same time, we can get images of the macrocosm and microcosm. Each image is presented in the form of information attributes – individual points of the image. Each point of the image is a separate source of information. This information is displayed in the brightness level

of each point of the image. An analysis of the location of the image points also provides information. Thus, the image provides primary and secondary information about the world.

To obtain secondary information, it is necessary to do image processing. For this special image processing techniques are used. Such techniques may be different [4], but for effective image processing and obtaining new data, preliminary processing of the original image is necessary. This allows you to improve the quality of the original image, the quality of additional information.

Thus, the main objective of this study is to consider the technique of image pre-processing in the analysis of natural polymer composites.

2. Material and methods.

To implement the pre-processing of the image can be used [5]:

– Image filtering methods. This allows you to remove defects that are present in the image,[6]

– Methods for changing the contrast of the image, [6]. This allows you to emphasize the characteristic features of the original image. This allows you to improve the visualization of the original image. Among the filtering methods emit median filtering. This is the simplest and most effective filtering method. This method allows you to minimize the effect of the filter on the original image.

The methods of changing the contrast of the image can be identified [7, 8]:

– histogram equalization of brightness values (luminance),

– non-linear stretching of dynamic range of brightness values,

– masks filtering,

– fuzzy masking.

To compare different images (original image, image after filtering, image after changing contrast), we use a histogram. The histogram is a graph that displays the distribution of the brightness levels of image points.

We also highlight segmentation methods. These methods allow you to split the image points into separate areas. For example: areas of the object that is being examined and areas of the background. Among the methods of segmentation it is possible to distinguish segmentation by color (or segmentation by brightness of image points). This is a simple segmentation method that allows you to split image points. Then we can talk about the estimates of the number of the plurality of points of the object and the background.

3. Image of the natural polymer composites.

To consider the ideology of pre-processing the image as a source of more information, we use of the natural polymer composites image (Figure 1 [9]). The scanning electron microscopy of the test samples were done by JSM 6390A (JEOL Japan).

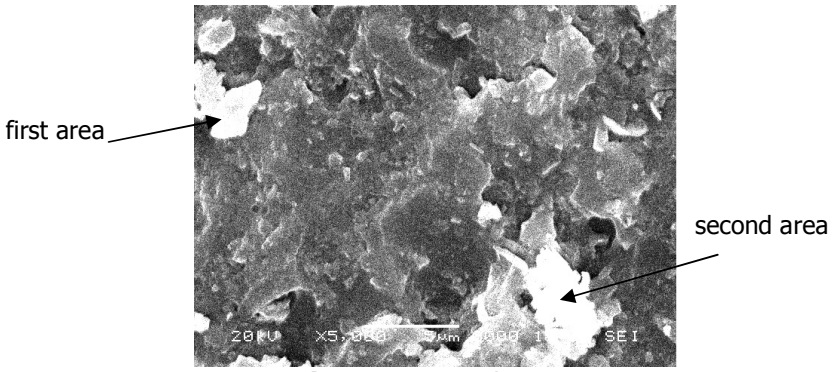


Figure 1. Original image

We also distinguish two areas in the image (see Figure 1). These areas play an important role in the study of the properties of natural polymer composites. These are the brightest areas that are the objects of study. Our task is to estimate the area of each section (count the number of points for each section). Such an assessment is made depending on the method of preprocessing. This estimate is compared with the opinion of experts.

4. Results and discussion.

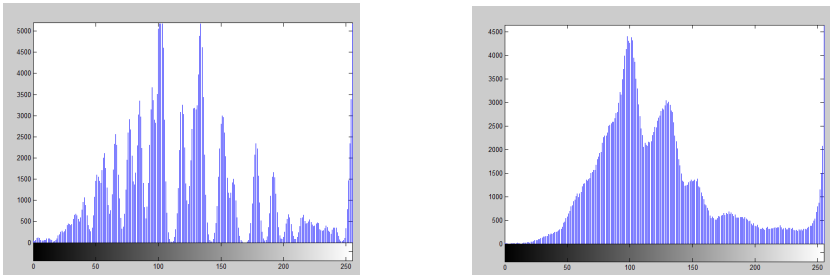
In the first stage of pre-treatment we do filtering the original image. In Figure 2 shows the histogram of the original image (Figure 2a) and the image histogram after filtering (Figure 2b).

Comparing the two histograms (see Figure 2), we see a significant change in the distribution of brightness in the image after filtering. Thus:

We removed the false dots on the original image,

We smoothed out the drastic changes between individual parts of the original image.

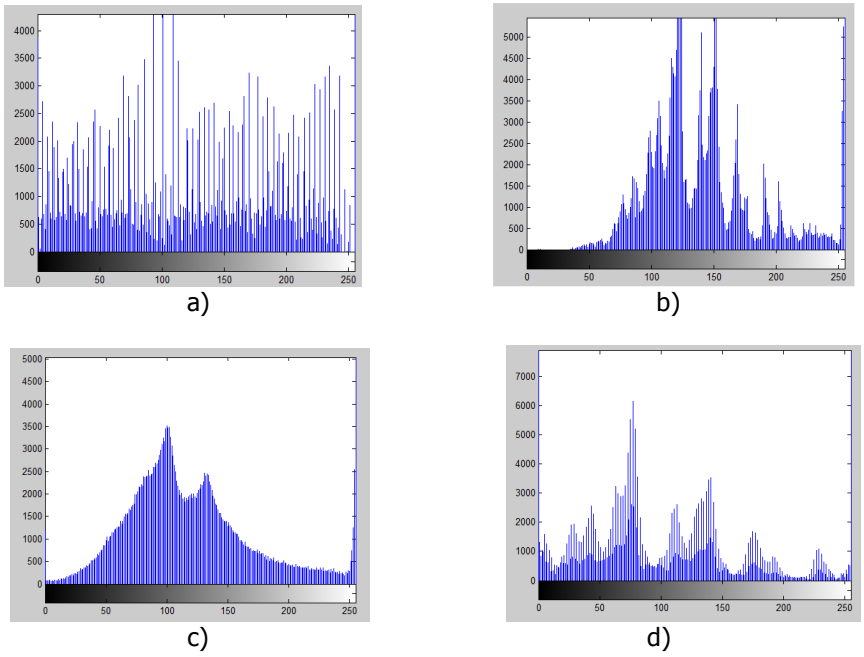
In the next image preprocessing step, we will change the contrast of the image after filtering. For this we use: histogram equalization of brightness values, non-linear stretching of dynamic range of brightness values, masks filtering and fuzzy masking.



a) for the original image b) for the image after filtering

Figure 2. Histogram of the original image and the image after filtering

In Figure 3 shows histograms of images after applying the procedure changing the contrast: histogram equalization of brightness values (Figure 3a), non-linear stretching of dynamic range of brightness values (Figure 3b), masks filtering (Figure 3c), fuzzy masking (Figure 3d).



a) b)

c) d)

Figure 3. Histogram of the image after change contrast

We can see a significant change in the distribution of brightness levels in the image after applying the procedure changing the contrast.

For each image, we also calculated the area of the two areas that were identified (see Figure 1). To do this, we used the segmentation procedure by brightness levels [3]. Table 1 shows the results of changes the area of the two areas that were identified.

Table 1. Area objects (pixels)

Objects	Expert opinion for the original image	Histogram equalization of brightness values (± %)	Non-linear stretching of dynamic range of brightness values (±%)	Masks filtering (± %)	fuzzy masking (± %)
1	8441	8372 (0.8%)	8643 (2.4%)	9702 (14.9%)	9971 (18.1%)
2	4001	3917 (2.1%)	3985 (0.4%)	3673 (8.2%)	4734 (18.3%)

We see that the best result is obtained after applying the procedure of changing the contrast with the help of histogram equalization of brightness values and non-linear stretching. This can be used when implementing the automatic calculation of the area of objects in the study of Natural Polymer Composites.

5. Conclusion

In this study, we examined various methods for pre-processing images. We compared these methods to each other. The comparison estimate was the area of the selected areas of the original image. As the image we used the image of natural polymer composites. The results obtained suggest the possibility of automatic processing of natural polymer composites images.

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