Application of the Ripley's K-function For Image Segmentation

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Abstract – **In this paper the method of image segmentation by application of point pattern characteristic is shown.**

Keywords – **Image segmentation, Point pattern.**

I. Introduction

Segmentation - the first and one of the main stages of image analysis, which aims to obtain information, contained in the image. The analysis includes proper segmentation of the image, distinguishing the object and determines its characteristics. The segmentation is crucial due to the fact that its results directly affect all the remaining stages of analysis, often significantly distorts the image

Well known problem of image segmentation can be solved by different approaches, namely by setting the threshold, finding edges, seed region growing and other similar. In order to avoid the significant deficiencies of known approaches the method of image segmentation, which is built on the basis of the strong association properties of mentioned above methods is proposed. It is offered to determine the initial regions for image segmentation, based on the properties of the mutual arrangement of image points, which are described by two-dimensional point processes - so-called point's patterns [1-3].

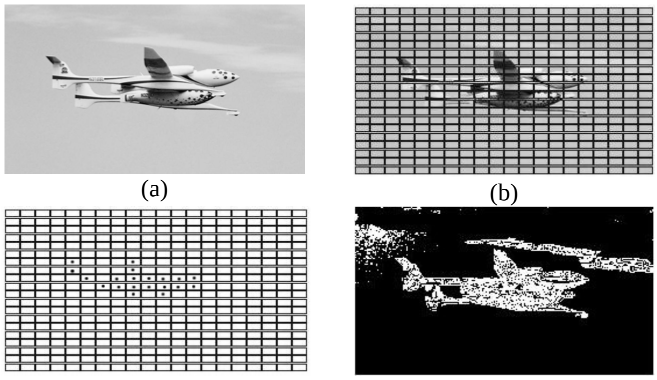
II. Method

Formally, we can consider a point pattern as the set of locations (s_1, s_2, etc.) in a defined region *R*, where points have been observed. The simplest theoretical model for a spatial point pattern is that of complete spatial randomness, where the events are distributed independently according to a uniform probability distribution over the region *R*. For every point pattern one important question arises: whether the observed points display any systematic spatial pattern or departure from randomness either in the direction of clustering or regularity.

A measure of spatial dependence of a point pattern is known as the *K*- function. This function is defined as mean of additional points within distance *h* of an arbitrary point around normalized by intensity of the pattern. In assumption of complete spatial randomness, it can be shown that $K(h) = \pi h^2$. If there is clustering, for short distances we would expect $K(h) > \pi h^2$. In the case of regular spacing, we would expect that short distances lead to $K(h) < \pi h^2$ [1].

For scenes with distinct structure "object/background", the obvious assumption that the points that belong to the object will form a compact set - cluster. This was applied to all intensities, which depicted object. Thus, selecting and combining together a set of different brightness, we can segment an object on the image or it substantial part. An image is divided into fragments (Fig.1b) and for each fragment dominant intensities are selected based on the histogram of fragment [4]. Fragments are chosen for each intensity from an image range, in which it is the dominant. The point of fragment centrepiece is put them in correspondence. Accordingly the point pattern is formed for each image's intensity.

Using the fact that for connected objects corresponding point patterns formed clusters, we made the initial determination of areas of image segmentation. Thus the proposed method allows selecting the initial area for objects that contain multiple levels of brightness.



(a) (b) (c) (d)

Fig.1 (a) – input image, (b) –fragments of image (a), (c) –points for dominant intensity, (d) –segmented image/

Conclusions

It is shown that image segmentation is possible by application of Ripley K-function which reflects the clustering or repulsion for points of pattern which obtained by fragmentation of the image and determination of dominant intensities.

References

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