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A NEW WINDOW SELECTION FOR LOCAL IMAGE THRESHOLDING UNDER UNEVEN ILLUMINATIONS

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Abstract. *Image thresholding is one of the most powerful techniques for image segmentation, but it is not always satisfactory in applications under uneven illuminations. Adaptive image thresholding is used to find the optimal window for solving the illumination problem. In this paper, a novel window selection method for adaptive local thresholding is proposed. Based on simulated annealing, the proposed algorithm searches the optimal window among partitioned subimages on the quadtree data structure from bottom up. It can be applied to other existing methods to improve the performance of image thresholding. Experimental results show the efficiency of the proposed method.*
Keywords: Adaptive local thresholding, Image thresholding, Image segmentation, Quadtree, Simulated annealing

1. **Introduction.** Image thresholding is a useful method in many image processing and computer vision applications, especially in image segmentations. It can be used to distinguish object and background pixels in a digital image by their gray-level values. The output of the bi-level thresholding operation is a binary image whose one part indicates the object and the other the background. The application of it can be found in recently published results [8, 16]. However, the illumination conditions will influence the thresholding results very much. Over the past years, some techniques have been proposed for selecting the threshold automatically. Sezgin and Sankur [14] provided an exhaustive survey and the comparison of performance measures over some of the image thresholding techniques. These thresholding methods were designed according to different information that exploited histogram shape, measurement space clustering, entropy, object attributes, spatial correlation, local gray-level surface, and so on.

Among the past results, the histogram of such an image might be considered as a powerful measure for thresholding since it represents the distribution of the image brightness. Using the shape of the histogram, it is possible to determine an optimal threshold value for segmenting the image into two sets with different brightness. In an ideal case, the histogram has a deep valley between two peaks that represent the objects and background. The gray-level value at the bottom of the valley can be chosen as the threshold. Clustering-based algorithms can be used to find the deep valley in the histogram [5, 12, 15]. Otsu [11] proposed a clustering-based thresholding by maximizing the between-class variance and minimizing the within-class variance. Even if the histogram of a gray-level image does not have two obvious peaks, Otsu's method can still provide a satisfactory result. Thus, it is widely used as the classical technique in real thresholding tasks.

However, if images are taken under uneven lighting conditions, it is difficult to carry out the peak analysis in the histogram such that the thresholding task may fail. One