Maximum Inter Class Variance Segmentation Algorithm Based on Decision Tree

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ABSTRACT

In image segmentation, there are always some false targets which remain in the segmented image. As the grayscale values of these false targets are quite similar to the grayscale values of the targets of interest, it is very difficult to split them out. And because these false targets exist in the original image, which are not caused by noise or traditional filtering methods, such as median filtering, they cannot be eliminated effectively. It is important to analyze the characteristics of false targets, so the false targets can be removed. In addition, it should be noted that the targets of interest cannot be affected when the false targets are removed. In order to overcome above problems, a maximum inter-class variance segmentation algorithm based on a decision tree is proposed. In this method, the decision tree classification algorithm and the maximum inter-class variance segmentation algorithm are combined. First, the maximum inter-class variance algorithm is used to segment the image, and then a decision tree is constructed according to the attributes of regions in the segmented image. Finally, according to the decision tree, the regions of the segmented image are divided into three categories, including large target regions, small target regions and false target regions, so that the false target regions are removed. The proposed algorithm can eliminate the false targets and improve the segmentation accuracy effectively. In order to demonstrate the effectiveness of the algorithm proposed in this article, the proposed method is compared with some frequently used false target removal approaches. Experimental results show that the proposed algorithm can achieve better results than other algorithms.

KEYWORDS

Decision Tree Classification, False Targets, Image Segmentation, Maximum Inter Class Variance

INTRODUCTION

Image segmentation is an important and complicated technique with many applications in image processing and analysis, such as computer vision, pattern recognition, medical image processing. The aim of image segmentation is to extract regions of interest from complex scenes.

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During the past decades, many different kinds of image segmentation approaches have been proposed. Generally, image segmentation methods can be divided into four types: image thresholding, image boundary based, image region based and mixing segmentation technology. Among these segmentation approaches, the thresholding method is widely used due to its simplicity and ease of implementation (Goh, Basah, Yazid, Safar, & Saad, 2018; Mittal & Saraswat, 2018). Its main idea is choosing a threshold which can distinguish the image background and target in the image. And the maximum inter-class variance segmentation algorithm (Otsu, 1978) is one of the classical image thresholding segmentation algorithms. It is a kind of global automatic nonparametric unsupervised algorithm and widely used, which takes the maximum inter class variance as measure criterion. While there is still a false targets problem in the maximum inter class variance segmentation algorithm. And the study of this paper is based on the segmented image which are segmented by the maximum inter class variance segmentation algorithm. After segmented by the maximum inter class variance segmentation algorithm, the segmented image is obtained which is composed of many independent regions (Li & Feng, 2016). Each region in the segmented image corresponds to a target. These targets contain not only the targets of interest, but also the false targets. And these false targets are not caused by noise but exist in the original image. It is difficult to split these false targets out effectively because their grayscale values are similar to the grayscale values of the regions of interest. For the segmented image, these false targets are interference, and the removal of false targets plays a very important role for image segmentation.

In recent years, in image segmentation field, the removal of false targets has been a hot topic. Over the past decades, a large number of related algorithms have been put forward by scholars. These algorithms can be divided into two classes: image preprocessing and image post processing. The principle of image preprocessing is removing false targets from the original grayscale image. And the idea of image post processing is removing false targets from segmented image. For image preprocessing, some filter algorithms, such as median filter, mean filter, anisotropic diffusion filter are widely used. For example, (Xiao, Cao, & Yuan, 2014) introduced anisotropic diffusion filtering to suppress the false targets and noise. Those image preprocessing methods may remove some false targets in the original image, but some useful information in the original image may be removed. In addition, Lu Bao Chun et al. (Lu, Li, Wang, Feng, & Li, 2011) reported that the edge of the target signal changes gently, and the corresponding gradient value is small, while the edge of the false signal changes relatively suddenly, and the corresponding gradient value is relatively large. According to this theory, the false target information in the gray image is removed and then the image is segmented. For image post processing, the methods based on filtering, mathematical morphology and area threshold gain a wide attention. Li Ming Xuan et al. (Li, Zhang, Meng, & Liu, 2013) used the median filtering algorithm to remove those false targets in the segmented image. Median filters are nonlinear digital filtering techniques and have been widely used to remove noises in the field of signal processing (Sun, Tan, & Chen, 2018). However, as these false targets are different from the noise in the general images, the median filtering cannot eliminate them effectively. Tuna’k Maroš’et al. (Maroš, Vladimír, & Caner, 2011) proposed to eliminate these pseudo targets by using mathematical morphological opening operations. This method can eliminate pseudo targets to a certain extent. However, if the selection of structural elements of the morphological opening operation is not suitable, the original segmented images may be deformed. Therefore, the mathematical morphological operations cannot achieve satisfactory results. In order to remove these false targets without changing the shape of the original segmented images, AMA Talab et al. (Talab, Huang, Xi, & Liu, 2016) proposed area threshold method which can remove the false targets according to the area of different regions. In this method, all the connected regions are marked, and the area of each region is calculated, and then the points in the regions of which areas are less than a given threshold value are removed. It could eliminate the false targets effectively. However, some small targets may be removed too, as the size of the small target region is always same as the that of the false target region, even smaller than the false target,
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