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## Edge Detection of Depth Image Based on Contour Curve

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# Edge Detection of Depth Image Based on Contour Curve

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**Abstract.** Edge is one of the most important features of an image because it recognizes the world through images and understands the position and contour of objects in images through edges. Edge monitoring of depth image is the basis of object recognition and location. The contour curve calculates the feature points and maps them to the original contour space. The original contour is matched by a sequence of markers. At the initial stage of recognition, the dissimilar targets and different gestures are eliminated quickly. The candidate list of targets is generated for accurate matching to improve the recognition efficiency. The curve is a nonlinear extension of the first principal component, emphasizing the search for the "middle" through the distribution of data, starting from an arbitrary point of the image, estimating the pixel points near the point and obtaining the gradient value. If the point satisfies the characteristics of the edge point, then the point detour depth traverses to find edge points that are perpendicular to the direction of the gradient and marks the visited points. And satisfy the self-consistent smooth curve without parameters, these curves give an overview of the data. Determine the degree of approximation; when the judgment has converged to the target contour, continue to converge and penetrate the concave area of the target contour.

## 1. Introduction

Depth image, also known as distance image, can directly reflect the three-dimensional characteristics of the object surface, and is not affected by illumination, shadow and other factors. Recognition can be divided into two categories: general object recognition and specific object recognition. The main difference between them is that the latter constructs highly specialized feature extraction [1]. A continuous and smooth closed contour curve, also known as the initial contour, is established near the contour of the object of interest. Then the closed contour curve is gradually approximated to the region where the gray value of the image changes greatly under the action of the curve itself and the specific image force field [2]. Accurate image edge detection results can not only greatly reduce the amount of information to be processed in image analysis, but also effectively acquire the image boundary structure. Methods based on edge detection, region, clustering and some specific theoretical tools [3]. After the squares of the two numbers on the corresponding positions of the matrix are added, a new matrix is obtained, which is the gradient value of the gray level of each pixel in the image. Finally, the edge of the image is obtained after threshold processing. The image data is converted into the frequency domain by some transformation method. The main energy of the transformed signal is concentrated in the low frequency part, and the noise and the edge of the image mainly appear in the high frequency part [4]. The general multi-resolution method is to generate a sequence of images in a regular manner, that is, the previous image is obtained by taking the mean of the adjacent four points constituting a small square as a point in the next image, thereby reducing the resolution of the image by half. Obtained [5].



The edge of the feature image is represented by the gradient magnitude of the pixel. The larger the gradient magnitude of the pixel, the more likely it will become the edge point. The smaller the gradient magnitude, the less likely it will be that the pixel is the edge point [6]. Because it gives the boundary curve directly instead of finding the discrete and unrelated edge points by the general method, it is very helpful for the subsequent processing of image segmentation, such as object recognition and other high-level processing [7]. It is important to select the appropriate structural elements for edge detection of digital morphology. Different detection effects can be obtained depending on the selected structural elements. The image segmentation problem is solved by detecting pixel edges of images containing adjacent regions [8]. Most of these methods are based on partial image information. Adjacent pixels with the same or similar local region features are aggregated together to complete the segmentation of the depth image, but the results of the operation often depend on the selection of the initial seed and the number of clusters. During the generation and transmission of images, due to the influence of hardware devices, noise is introduced, which interferes with the correctness of the high-frequency signal at the edge of the detected image. Convergence is considered to end when the total energy no longer changes or periodically fluctuates or reaches a set number of iterations [9]. In the process of energy minimization, each iteration is calculated, and the original vertices are replaced by searching for the minimum energy points in the neighborhood of each vertex. The contour is characterized in the form of a sequence of marker points, and similarity matching is performed with the contour information data, by excluding the category and posture with lower similarity [10].

## 2. Materials And Methods

As an important feature of contour curve, markers determine the shape of the object in the image. This method uses Legendre polynomial to approximate contour curve to eliminate noise interference. In some cases, edges need to be enhanced to highlight points whose local gray values have obvious changes. The contour curve is used to distinguish the real edge points from the false edge points and to determine the final edge points. The curvature will jump when the two surfaces meet at the intersection edge, the occlusion of the surface or the edge of the fold. Applying this feature, the edge of the image can be extracted. Open curves will not pop up until their edges are detected. Whether the curve is noise or edge can be further processed. The contour curve is attracted to the target edge, and when the contour curve reaches the equilibrium position, the value is lowered to enable edge detection on a finer scale. The boundary-based and region-based methods respectively play the participants of the game. The segmentation process is performed in an iterative manner, with each player changing the strategy based on the results of the previous step. The parameters are not the same, they are not adaptive. The threshold is too high, many edges cannot be detected, the threshold is too low, many non-edge pixels will be misdetected as edges, and edge detection acquisition parameters are shown in Table 1.

Table 1 Edge detection acquisition parameters

	Testing	output
Image acquisition	7.63	0.35
Edge extraction	6.19	0.42
Edge location	8.33	0.18
Edge processing	9.26	0.23

All the pixels in the original region are set to unused, and then the same seeds are used in the region and the new estimated error values are used to implement the growth algorithm. When a blunt angle is formed between two straight lines, this method is expected to form a new error, which can find the region containing seed pixels. The process of parameter active contour segmentation is to make the contour curve close to the edge of the object under the action of external energy and internal energy, and the external force drives the contour to move, while the internal force keeps the contour smooth. The curve will pass through an edge curve that has already been visited, and the point that passes through

is not the starting point in a traversal process. The control points on the curve are constantly updated as it continues to deform. Due to the non-convexity of the energy function, some invalid or too concentrated points are generated, which ultimately leads to unstable or false detection of edge detection. edge. The modulus of the first derivative of the curve reflects the continuity of the curve. The smaller the modulus, the better the continuity of its representation, and the more discrete the discrete points that make up the curve, as shown in Figure 1.

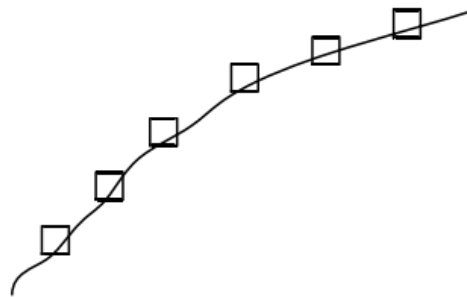


Fig. 1 Continuity of Curves

Most of the main information of the image exists in the edge of the image. The edge is the most important feature of the image. It is the set of those pixels whose local feature is discontinuous and whose gray scale of the surrounding pixels changes step by step or the roof changes. Because the depth image is not affected by the illumination intensity and the surface characteristics of the object, it directly reflects the depth information of the object, and can be recognized by using the structure information of the object surface. When learning, a certain number of training signals are given, and the difference between the actual output and the expected output is calculated to adjust the weights, so that the output value is close to the expected output value. The complete segmentation of the depth image can be achieved independently, or it can be used as a pre-processing of the region method to provide the correct seed region. The parameters of the initial curve are changed according to the image data optimization objective function, and the image data is fitted to obtain a specific curve determined by the image data. To satisfy the characteristics of the edge points, the point is pushed onto the stack. From this point on, the depth traverses to find edge points that are perpendicular to the direction of the gradient and marks the visited points. The general shape of the object can be determined by extracting the boundary of the object. In essence, this method is to represent the image as an edge curve and set the boundary of the original image according to appropriate structural elements. Then, the morphological transformation of the edge of the extracted image outline is as shown in Figure 2 .

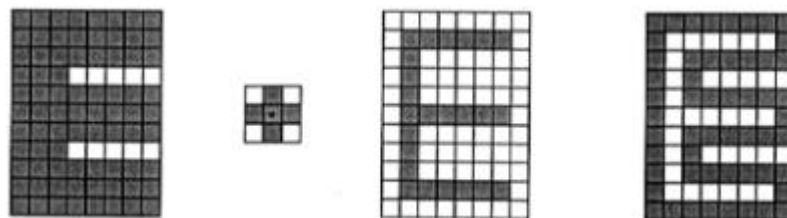


Fig. 2 Sketch of Edge Detection

### 3. Result Analysis and Discussion

Horizontal regions are composed of independent random variables at each pixel. But the computed horizon area will never be completely independent, even in white noise images. In fact, adjacent pixel values are used to calculate gradients. Whether the edge points are real edges or not, and connect discontinuous edge points. Finally, region-related processing is carried out: region growth and region

merging, some small circle edges generated in the segmentation process and other issues are dealt with. At the important edges, the pressure value should be slightly less than that of Gauss force, but it can ensure that the model can cross weak edges or blurred edges. When the initial contour is inside the target, the contour curve can converge to the edge of the target steadily because of the force. Direction selection follows the principle of anticlockwise. If there are several edge curves passing through a point, they are traversed in anticlockwise order. Taking into account the particularity of the edge of the depth image, different intensity operators are used for different kinds of edges to achieve edge detection of the entire image. Provides rich orientation and shape to capture the geometry in the image and accurately capture the edges of the image into sub-bands of different scales and frequencies. The essence of principal component analysis is a statistical average in the sense of mean square error. To illustrate the relationship between information description length and information retention, the relationship between information description length and information retention is shown in Figure 3.

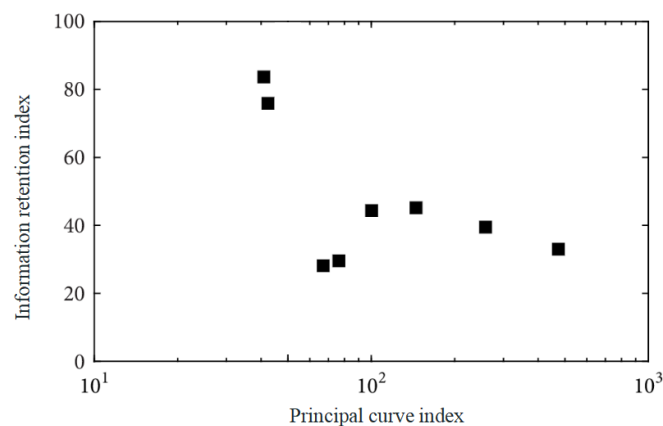


Fig. 3 the Relation between Information Description Length and Information Preservation

The obtained feature points deviate from the salient position of the original contour. At the same time, even after smoothing, the contour curve may still be disturbed by noise, leading to very close between markers. If the maximum error is greater than the right appendix value, the line segments will be separated at the maximum error, and then the curve fitting will be carried out separately until the fitting error of all curve segments is less than the alarm value. Continue depth-first traversal with a new starting point until all vertices (also known as vertices reachable from the source point) in the graph that are path-connected to the source point have been accessed. By defining the potential energy function of the basic distance map, a force field with a large capture area can be obtained, but since the distance map is a mapping relationship between the pixel point and the edge point closest to it. The adjacent edge point is more attractive to it, and its neighborhood will become a gray level change band. The two most useful features for this variation are the rate of change and direction of grayscale, which are represented by the magnitude and direction of the gradient vector, respectively. The difference is measured by the standard deviation of the edge pixel neighborhood pixels. In order to reduce the noise interference, when calculating the neighborhood standard deviation, the gray value standard deviation of the remaining pixels is calculated after removing a gray maximum value and a minimum value. The purpose of binarizing the output image is to make it easier to directly observe the edges.

The first principal component characteristic of curve inheritance is that if the given variable is located on the hyperplane orthogonal to the first principal component, the conditional mean of elliptic random variable is the intersection of the hyperplane and the first principal component. Usually, we recognize targets, and most of the extracted features only consider whether they have translation, rotation and scale invariance. In order to preserve the edge and texture of image effectively while denoising better, we have to make up for the blurring of edge and texture in the process of denoising. However, the commonly used enhancement method is to enhance the image as a whole, instead of only

enhancing the edge and texture information. In order to avoid confusion with the external contour and reduce the operation time, the threshold can be determined by the maximum search distance. Dynamic distance force can actively attract the target edge in a larger capture range, and the attraction range can be limited by the threshold. The edge does not necessarily correspond exactly to the boundary in the actual sense. Compared with the previous methods, the proposed algorithm mainly solves the first problem. The depth-first traversal of the edge points can form a closed curve and mark the corner points. Some of the main edges are not extracted, but there are many isolated edge points at the non-edge, which cannot be processed later. The under-segmentation and over-segmentation after the region fusion are intertwined. It has good adaptability to dynamic environment and strong anti-interference ability to noise and background. However, it is impossible to extract all relevant points of the target, and it is easy to form a void inside the target, and the background is required to be stationary or unchanged.

#### 4. Conclusion

In this paper, the edge detection method of depth image based on contour curve is studied. Morphological processing is carried out when the contour is obtained. At the same time, the sensitivity of contour curve to noise is much lower than that of contour curve. Under given initial conditions, the edge of the target in the image is searched by iteration step by step, using its own curve characteristics, image energy and external force. The energy functional of the curve is minimized when the boundary of the real object is approached unrestrictedly. For a continuous surface, the sum of the second-order partial derivatives of each pixel is sampled from the continuous surface, and the result is still decimal rather than integer. In the mixed images of targets and scenes, the method proposed in this paper has strong target understanding ability, is more suitable for extracting object contours, and effectively suppresses the edges of non-target objects. The contradiction between edge positioning accuracy and anti-noise performance can be better balanced, which is very advantageous for understanding the subsequent depth image. The edge discontinuity in the figure is caused by the discontinuity of the edge of the original three-dimensional image itself. The feature pixels such as edge points and corner points in the image can be relatively completely recognized, the redundant edge points are well removed, and the discontinuous edge points are connected, and a closed contour composed of edge point sets is generated; in order to prevent leakage Phenomenon, the results of edge growth were regionally grown and merged, and good image segmentation results were obtained.

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