Research of Image Mosaic Algorithm Based on Harris Corner Detection

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Abstract. This paper studies the general steps and methods of the image matching technology. Using a set of optimized Harris corner detection algorithm, a similar measure extracting feature points by the maximum correlation coefficient to achieve accurate matching. Finally, the weighted smoothing is performed to realize the seamless splicing of the two images according to the bilinear interpolation of the adjacent position of the overlap region.

Introduction

With the continuous development of imaging technology, image stitching technology is widely used in medical impression analysis, virtual reality and other fields. In this paper. Harris operator, detected corners an optimal set of eigenvalues, it is proved by experiments that the improved algorithm can effectively improve the extraction of feature points of the courier and accuracy, reducing the error rate of image matching.

Harris corner and nature

The corner point is also known as the point of interest, which is in every direction its neighborhood gradation change amount large enough. It is a kind of important image feature points, which contains rich one-dimensional structure information, and is widely used in various image processing techniques. In this paper, the selection of Harris conroner is as feature points for image matching.

This operator has a matrix of the autocorrelation function associated M. The eigenvalues of the matrix M are first order curvature of the autocorrelation function. If its horizontal curvature and vertical curvature are higher than other points in the local neighborhood, it is considered that the point is the feature point. It is computationally simple and effective and is very stable. Its calculation is simple and effective and very stable, It is a feature extraction operator compared with other operators under the condition of image rotation, gray, noise and viewpoint transformation.

Based on Harris corner theory, get the following corner extraction steps:

(1) the use of horizontal, vertical difference operator for each pixel of image filtering in order to achieve I_x and I_y, then obtain four elements values of the matrix M:

$$m=\begin{bmatrix} I_x^{\ 2} & I_x I_y \\ I_x I_y & I_y^2 \end{bmatrix}, I_x^2 = I_x \times I_x, I_y^2 = I_y \times I_y$$

(2) The four elements of the matrix m are smoothed by Gauss filter,and the new matrix M is obtained. $Gauss = \exp\left(-\dfrac{(x^2+y^2)}{2\pi\sigma^2}\right)$

(3) calculate the corresponding amount of each pixel corner cim (i.e. R) by M:

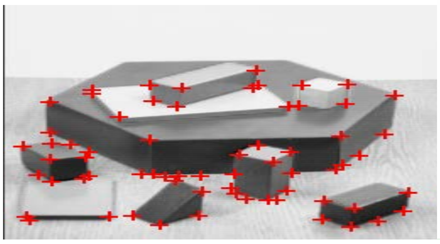
$$cim = \frac{I_x^2 I_y^2 - (I_x \times I_y)^2}{I_x^2 + I_y^2}$$

In the matrix cim ,at the same time, the two conditions are considered as the corner point ,which is greater than the threshold threah and is a local maximum of a certain field.Increase the threshold,the number of corners extracted is reduced;reduce the threshold, the number of corners extracted increases.Also local maxima in the field will also affect the size and the number of corners extracted tolerance.

The characteristics of check results of Harris operator

Obtained by using the algorithm of a figure 1 Harris corner parameter setting system and figure 2 Harris corner points:

Fig.1 Harris corner parameter setting system



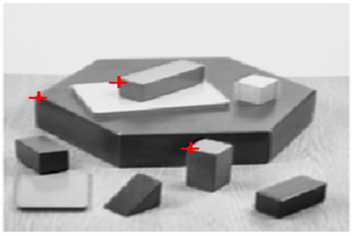


Fig.2 Harris corner points Fig.3 Optimal corner

Best Feature Selection

Due to an excessive number counted by Harris corner to extract is not conducive to the image matching speed, it is necessary to select the most characteristic corners as the matching candidate point.This experiment selects three of matching feature points as the best candidate points.

In this experiment each picture has 30% -50% of the overlapping area, you can select each image in the overlapping area optimal corner point by following these steps:

(1) the overlapping area is divided into four equal parts,pattern of a 2 * 2,in each region to form a queue in accordance with the descending threshold size corner and record the coordinates of each corner point;

(2) it will have four queues, choose three corners A1 (x1, y1) in these four queue using iterative methods, A2 (x2, y2), A3 (x3, y3), and these three corners are not collinear: $\frac{x_1-x_2}{y_1-y_2} \neq \frac{x_1-x_3}{y_1-y_3}$

Record these corners.

(3) In the corner of the second step angle, select such corner points,ensure tha the threshold value of each two points, the threshold ratio is small, and the slope ratio of the two points constitute a straight line.

The extracted according to the method of the 3 most corners as shown in figure 3.

Image Registration

Set m_1, m_2 is a set of images corresponding to the image feature points I_1 and I_2, the projection is transformed I'_1 and I'_2 . m'_1 , m'_2 are the corresponding point m_1, m_2 transformed.Because of the error match point, the match error may occur if the image directly translational makes point to point, and sometimes may not be correct splicing results (see Figure 4).

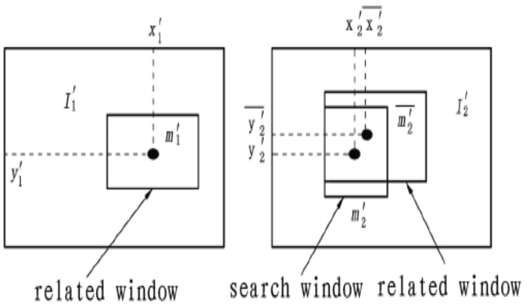


Fig.4 Suture point searching diagram

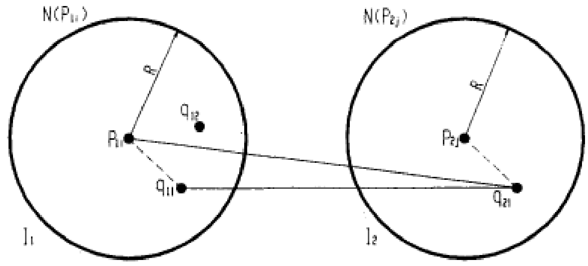


Fig.5 matching the intensity of the "asymmetry" schematic

For the image of I'_1 feature point m'_1, set its coordinates (x'_1, y'_1), and the point is defined as the center of a size (2n + 1) (2m + 1) correlation window.The coordinates of m'_2 (x'_2, y'_2), select the search window in the second images to the point as the center, the size of the (2s+1) (2t+1) window,then use the region $\overline{m'_2}$ point and the feature image I'_2 n operating in a given relevant window,to set the coordinates $\overline{m'_2}$ $(\overline{x'_2}, \overline{y'_2})$, the point correlation value *Score* m'_1 and $\overline{m'_2}$ is defined as: $Score(m'_1, \overline{m'_2}) = \dfrac{c\,\mathrm{ov}(m'_1, \overline{m'_2})}{\sigma(m'_1)\sigma(\overline{m'_2})}$

Wherein, $\mathrm{cov}(m'_1, \overline{m'_2})$ represents the point m'_1 and $\overline{m'_2}$ of covariance in its associated window. $\sigma(m')$ is the standard deviation of the image I' in point (x', y') as the center, the size of the image $(2n+1)(2m+1)$.

From the formula ,the correlation value *Score* is in the range from -1 to 1, the more similar points m'_1 and $\overline{m'_2}$, the correlation value is greater.In the actual matching process, make sure a valid correlation value threshold, when using a relative value calculated at $\overline{m'_2}$ is greater than the threshold, this point can be thought of as a candidate matching feature point m'_1.Because each feature points in the image I'_1 may correspond to the multiple feature points in the image I'_2, each candidate matching point pair (x'_1, y'_1) has the similarity to all (x'_2, y'_2).If the candidate matching point directly to the similarity obtained by adding matching strength, there will be a question of asymmetry that matching the intensity of a match point and, in turn, it is not likely the same calculated, that is $Strength(x'_1, y'_1) \neq Strength(x'_2, y'_2)$. Shown in Figure 5.

The solution is:When calculating the $Strength(x'_1, y'_1)$, I'_1 for image in the neighborhood of each point calculats with the image I'_2 in individual matching corresponding points of similarity in the neighborhood,taking all their similarity maximum;Similarly, when calculating the $Strength(x'_2, y'_2)$,the image in the neighborhood of I'_2 calculates the degree of similarity with the image I'_1 in the neighborhood of each point corresponding to matching every point, taking all of their maximum similarity; and then calculating the sum of the two is required match intensity. Formula is as follows: $Strength(x'_1, y'_1) = Strength(x'_1, y'_1) + Strength(x'_2, y'_2)$

Such symmetry obtained matching strength meeting the requirements, if matching the strength of a candidate matching point is zero, it is considered false matches. Figure 6 is the matching point set . Figure 7 is the use of feature points to the matching after the stitching map. Figure 8 is the image after the fusion process.

Fig.6 the matching point set

Fig.7 the use of feature points to the matching

Fig.8the image after the fusion process

Conclusion

In the process of registration, the article adopts the method of block registration registration, here to choose the size of the window for 7 * 7, search method for local search, according to the similarity measure, to determine the matching feature points.With three pairs of matching feature points, according to the overlap adjacent position of bilinear interpolation, weighted smoothing in order to achieve the seamless splicing. The experimental results show that the improved algorithm can effectively improve the feature points extracted courier and accuracy, and reduce the image matching error rate.

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