International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE)
ISSN: 0976-1353 Volume 22 Issue 2 – MAY 2016.

A STUDY ON MATCHING OF LARGE IMAGES

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***Abstract*— Image matching is one of the active areas of research in today's world. There exist many ways in which two images can be matched. When matching two images, size of the image plays a very important role. If the size of the image is small then matching of images will be easy and cost of computation will be less. But if we are handling massively-sized images, image matching will incur large computational cost. This paper focuses on the different methods of image matching which can be applied in matching large images.**

***Index Terms*— image matching, massively-sized images, computational cost, computational speed, accuracy of matching, SIFT.**

I. INTRODUCTION

In image processing applications, image matching is one of the important steps. Image matching is used in image registration, object recognition and tracking, image retrieval, stereo and 3D reconstruction, forgery detection, etc. It is also widely used in the fields such as, remote sensing, medicine, artificial intelligence, etc.

With the advancement of digital cameras of high resolution and photo editing software with advanced features, the chances of image forgery has increased. Image trustworthiness is more in demand nowadays. Images for evidence in courtrooms, digital images used by doctors, images in magazines and newspapers are some of the cases that demands for images with no manipulation. With theses photo editing software, people can easily edit images and present the edited copy as the true copy. The changes are done in such a way, that it is undetectable by human eye.

The challenging task in image matching is to determine how far the reference image and the target image is matching. The main aspects of matching are its computational cost, computational speed and the accuracy of matching.

The size of the image plays a very important role in matching two images. So, it is clear that, the computational cost required in matching two small images is far less than the cost required to match two large images.

One way to circumvent the substantial computational cost when dealing with large images, is by using pyramidal schemes. Pyramidal techniques employ a number of sub-sampled versions of the reference and the target image to propagate matching results from the coarsest to the finest resolution. But the drawback of these techniques is that, the mistakes made at any one level of the pyramid, will be amplified at the finest resolution level.

II. REVIEW

A. *"Matching of Large Images through Coupled Decomposition"*

Sidiropoulos and Muller presented, a theoretical analysis of the performance of the full-image matching approach. They demonstrated its limitations when it is applied to large images. Subsequently, a novel technique to impose spatial constraints on the matching process was introduced.

This technique was named as coupled image decomposition. It contained two parts: Coupling and Decomposition. In the coupling phase, they worked with the corresponding points of two images and compute the orientation angle difference between those images. In decomposition phase, they used this orientation angle difference between the two images to decompose the images into m radial sections. After presenting it, the authors demonstrated how this technique can be used both for image registration and for automatic estimation of epipolar geometry.

Further in this paper the authors improved the coupled image decomposition algorithm by integrating it with feature extraction algorithm. They mentioned that instead of using two root points of the two images, points generated by SIFT could be used. In the last part of the paper the authors proposed to use coupled image decomposition with enhanced fundamental matrix computation for image matching.

After experimentation they found out that the accuracy of image matching using the proposed method was not optimal and some improvement could be done to improve the accuracy. [1]

B. "An Improved SIFT Feature Matching Algorithm Based on Maximizing Minimum Distance Cluster"

Wang Kai, et. al. presented, an algorithm for image matching which is based on SIFT(Scale Invariant Feature Transform) algorithm and Maximizing Minimum Distance Cluster algorithm.

In the first part, features are extracted from the images using SIFT feature extraction algorithm. This features are then subjected to maximum of minimum distance based cluster algorithm.

The authors have proposed that by applying clustering to SIFT feature points, noise and similar surface features that results in the mismatch points are removed.

In the second part, the authors have proposed consistency detection algorithm for image matching. They say that any line segment before or after the transformation has the same ratio as that of the transform.

In the last part of the paper, the authors have presented an optimized SIFT feature matching algorithm. The authors propose to extract a large number of matching points as initial candidate feature points using original SIFT algorithm. Then create a kd-tree data structure according to the feature points and its feature vector in the image.

Then by applying the maximum of minimum distance cluster algorithm, select the matching points from the above matching points detected.

Last, according to the principle of consistency test, compute the line segments composed by the precise matching points and check if the ratios are equal. [2]

C. "Image matching algorithm based on human perception"

Mrigank Sharm and Amrita Priyam, designed a user-oriented image matching system which operates in three phases.

In the first phase, the system is queried by the user by providing a sample image as the input.

In the second phase, a similarity between database images and the query image is computed by the system. The similarity is computed by the similarity measurement module of the system which compares the query features with those features of images in the database and finds the most similar images to the query image. Using the similarity value, the images are ranked. This rank under each database image enables the user to see which images are relevant and which are not. The rank value represents the degree of relevance. Higher the rank higher the relevance.

In the third phase, matching is done. The system retrieves and presents a sequence of images ranked in decreasing order of similarity.

After experimentation they found out that the results of the proposed approach have shown the significant improvement in matching performance.[3]

D. "An Image Matching Method for Digital Images Using Morphological Approach"

Pinaki Pratim Acharjya and Dibyendu Ghoshal presented, a method in which images can be matched using morphological approach.

In the first step, they converted two real life images into gray scale images. In the next step, they generated morphological gradients for feature extraction and edge detection.

Then they compared the morphological edge values of two images pixel by pixel. They proposed that if the matching is greater than 90 Percent of the total pixels of the two different images, it can be considered that the images are same; otherwise the images are different images.[4]

E. "An Accurate Image Matching Algorithm Based on Multiple Constrains"

He Zhen, et. al. proposed, a matching algorithm based on multiple constraints. The constraints used in this algorithm are affine transformation constraints, epipolar constraint, unique constraint, gray correlation constraint and RGB correlation constraints.

Initially, they determined, some control points based on some feature points and the texture relation between the two images. Then using the control points, they constructed, a global affine transformation matrix and fundamental matrix. They used this matrix to transform the feature points on one image to the conjugate one. Then, the matching points are further searched by using epipolar geometry constraint and gray-scale correlation. Finally, to get accurate matching points, a new RGB correlation constraints are applied. This algorithm works in 3 steps.

In the first step, they first detect the feature points from the left and right image and then do interactive matching for the feature points. Next, gray correlation constraint is utilized to correct the matching points, and the initial matching points are obtained. Finally, they construct the global affine transformation matrix M and fundamental matrix F using the initial matching result.

In the next step, for each point of the left image, they applied four constraints serially in order to get the exact matching point. Initially, the candidate matching points are obtained by applying the affine template constraint. Then epipolar line constraint was used in order to get a new set of candidate matching points. Next, gray-scale correlation constraint is applied to get the matching points. Finally they used RGB correlation constraint matching to get the exact matching point.

In the last step, pruning is done to remove out incorrect matched points. To correct the errors found in the matching result, they used epipolar line constraint and unique constraint to check all the matching points. Points satisfying the two constrains will were kept, rest were removed.

After experimentation, they found that this algorithm converges fast and can increase matching precision effectively.[5]

F. "A Method of Infrared/Visible Image Matching Based on Edge Extraction"

Zhenbing Zhao and Rui Wang proposed, a method for infrared/visible image matching. This method was based on edge extraction by using SURF algorithm.

The authors mentioned that, for the gray intensity and the detail features differ greatly in the two kinds of images, infrared/visible image matching could not be completed by directly using SURF. Although their edge features are not completely consistent, the general positions of edge are consistent at large scale. These corresponding edges can be the matching base. They divided the method into four parts.

i)Extracting the infrared/visible images edge by using Canny operators.

ii)Using SURF, detect and describe the features of the edge images.

iii)Using Euclidean distance obtain the rough matching of descriptors at first, and using the nearest neighbor distance ratio as matching strategy to get original matching pairs.

iv)Using robust RANSAC method eliminate external points, the result will be the precise pairs of feature points.

After Experimentation they found that, the results prove that this method was fast and performed well.[6]

G. "An Image Matching Algorithm Based on Sub-block Coding"

Yuping FENG et. al., proposed a new template matching method which was based on local gray value encoding matching and phase correlation. They divided the matching process into two parts: rough matching and fine matching.

In rough matching, they divided the image into certain size blocks named as R-block. Next, they summed the gray value of each R-block pixel, encoded the R-block according to the gray value distribution of R-block with the adjacent R-block, and matched it by step between the template and each search sub-image.

Fine matching was done by using phase correlation, as per initial match parameters.

After experimentation they that, the new algorithm is faster than traditional algorithm by two orders of magnitude, and the speed has improved twice compared to the existing sub-block coding method.

They mentioned that, the Experiments demonstrated the new algorithm as robust to the linear transformation of pixel grey value and image noise.[7]

H. "An Image Matching Method Based On the Analysis of Grey Correlation Degree and Feature Points"

Zishuo Ding et.al., proposed an image matching method that was based on grey correlation degree and feature points. The authors focused on the accuracy of image matching using SIFT algorithm to extract feature points from images.

After extracting the feature points, they used the feature points to find out the matching points between two images. Matching points were found out by calculating the correlation degree based on the Analysis of Grey Correlation Degree.

After experimentation, they compared the results with the original algorithm, and it was found that the matching time was almost the same, but the algorithm proposed in this paper had higher matching accuracy and robustness, could adapt to the requirements of image recognition in various conditions and could eliminate the influence of stretching, rotation and illumination change.[8]

I. "Image Matching Based on Two-Column HistogramHashing and Improved RANSAC"

Bin Li, et. al., proposed a fast image matching method that used a coarse to fine searching strategy. The method was based on two-column histogram hashing and improved random sample consensus (RANSAC). Initially, they did coarse matching using a novel TCH hashing. Then, in the refining stage, key points were detected and described in the coarser scales using scale-invariant feature transform. Finally they implemented matching using Euclidean distance strategy and the improved RANSAC based on prior energy function (P-RANSAC).

They conducted experiments on various SAR images. The results showed that the proposed approach outperforms the state-of-the-art algorithms in SAR image matching.[9]

III. Conclusion

In this paper several image matching algorithms are discussed. The pros and cons of each image matching algorithm are stated. These algorithms can be applied be applied to small as well as large images.

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