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Image Matching Technique to Track Copyright and Duplication of Images

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Abstract—*The paper focuses on the investigation of the illumination-invariant property of the PC image matching method using mathematical analysis along with the SURF algorithm and estimation of scale invariance using the SIFT algorithm. The SAI Space, calculated under different illumination is used to analyze the cross-power spectrum fringes of the PC between two images. The edge detection, Fourier transform and noise threshold are obtained in the PC domain. The PC and SURF algorithm is able to achieve the reliable image matching results under significant varying conditions like illumination and shift of the image and scale invariance is estimated using the SIFT algorithm in different size of the images.*

Keywords*: DEM, FSIFT, Image matching, SIFT, SURF, Phase correlation.*

1. INTRODUCTION

Image matching is the process of bringing two images together into agreement so that matching pixels in the two images matches to the same region of the area being imaged. Matching algorithms plays a key role in deciding correspondences between two image scenes. Area based matching and feature based matching algorithms are two types of the matching algorithms. Image matching can be applied to number of applications that require the functionality of identifying and searching of matching images.

The main key issues of various image based applications, such as change detection for map updating and automated navigation based on optical vision. A major challenge for matching images taken in different times is the illumination variation that may cause decorrelation between the images. This illumination invariant of the images can be resolved using the PC (Phase correlation) algorithm. The challenges in local-feature-based image matching are variations of sight and illumination. Many methods have been recently proposed to address these problems by using feature detectors and descriptors. However, the matching performance is still unstable and inaccurate, particularly when large variation in view or illumination occurs.

This paper describes the investigation of the illumination-invariant property of the PC image matching method via mathematical analysis along with the

SURF algorithm and estimation of scale invariance using the SIFT algorithm. The PC algorithm is able to achieve the reliable image matching results under significant varying conditions.

The proposed system shows theestimation of the scale invariance and the image shift using the SIFT algorithm to improve the matching of the images and reduce the error rate of existing system.

2. RELATED WORKS

The aim of the illumination-invariant matching algorithms studies is to find unchanged spatial features or patterns under different lighting conditions. Two typical approaches are feature based and frequency based. There were a lot of research works on image matching methods. David. G. Lowe [2] presents a reliable matching method of extracting distinctive invariant features between images having different views of object or place. The features are invariant to image rotation and scale, distortion, 3D change viewpoint, addition of noise, and illumination change and are highly distinctive.

SIFT (Scale Invariant Feature Transform) [3] a new algorithm developed by M. Aly is used to estimate the reliable matching features between images that are extracted to different views of the same object. The extracted features from images are highly distinctive and are invariant to scale and orientation of the image. The experiment of SIFT is done in the face recognition. J. Krizaj [4] introduce a new method called FSIFT (Fixed-Keypoint SIFT) to overcome the inaccuracy of SIFT. The procedure of FSIFT method is obtained by computing the SIFT method at fixed predefined image locations described during the experimental stage. Fixing the keypoints to predefined spatial locations will helps to eliminate the threshold optimization and face image partitioning.

D. R. Kisku [5]described a new Graph Matching Technique on SIFT for face identification system based on features extracted from face images based on Graph matching topology in SIFT features which is invariant to rotation, scale and translation. A robust face recognition technique[6] based on the matching and extraction of the SIFT features of independent face areas. Both global and local matching strategy is proposed. The proposed local matching technique is based on matching individual salient facial SIFT features by considering the facial landmarks such as the eyes and the mouth of the image.

A different ranking of SIFT features[7] adopted by A. Majumdar that can be used to reduce the number of SIFT features for face recognition. This method checks the number of irrelevant features to be matched in order to reduce the computational complexity and also increases the recognition accuracy.B. Herbert [8] describes a new method Speeded Up Robust Features (SURF) - a fast and good performance interest point detection-description method, which perform the current state-of-the art, in both speed and accuracy. SURF descriptor is based on similar properties with a compressed complexity.

An illumination invariant transform[9] method byW. Maddern to improve many aspects of visual localization, mapping and scene classification for autonomous road vehicles. The illumination invariant color space stems from modelling the spectral properties of the camera and conjunction in illumination of area, and requires only a single parameter derived from the image sensor specifications. O.Arandjelovic [10] developed a novel gradient edge map representation for frontal face recognition. The illumination conditions considered include the dominant light source placed behind the side of the user and directly above and pointing downwards and upwards.

A stereo-matching algorithm [11] by G. L. K. Morgan relating to the robust phase correlation method. The algorithm mainly focus on the technical step of subpixel disparity estimation within the depth-from-stereo processing chain.

3. PROPOSED SYSTEM

The image matching technique is mainly used in the area of space research for tracking the duplicate and copyright satellite images. In the existing system the scale invariance is not estimated and the error rate is high.

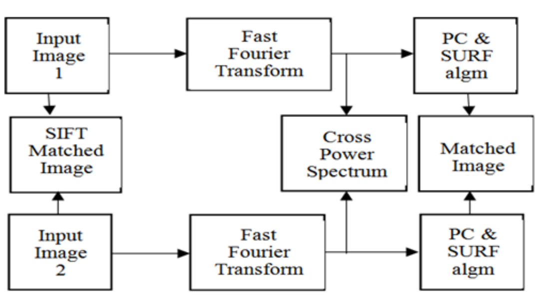

Fig. 1. Proposed system framework.

In order to solve this problems in the proposed system the SIFT algorithm is used with the PC and SURF algorithm in the existing.

A. PC IMAGE MATCHING METHOD VIA MATHEMATICAL ANALYSIS

The illumination-invariant property of the PC image matching is calculated via mathematical analysis. The framework includes estimation of SAI space, estimation of PC-based illumination invariant.

i. Estimation of SAI Space

The estimation of the SAI Space is obtained by considering the brightness of a surface is considered as the intensity$I$, under given sun illumination L, which depends on the angle between the terrain surface normal and the sunlight incident direction. The direction of the sunlight incident is described by zenith and the height of the sun is measured in vertical, and the azimuth angle is the direction of the sunlight. Similarly, the vector of surface normal is determined by slope, the dipping angle of the land surface, and aspect is the directions of the surface. Then the equation (1) can be,

$$I = L(cos(zenith)cos(slope) + \sin(zenith)\sin(slope) \times cos(azimuth - aspect))$$

ii. Estimation of PC-based illumination invariant

a) PC

PC is an image matching algorithm based on the shift property of Fourier transform. For the estimation of illumination invariant we have taken two similar image that are related by a simple translational shifts. The Fourier transforms of the input and the translated images are ploted. Cross multiplying the FFTs of the input image and the conjugate of the translated images results in the cross power spectrum. The cross power spectrum shows the edges of the two images.

b) Effect of Azimuth Angle on Image PC

The azimuth angle variation results in the compression at one side and enlarge to the other side of the surface in the aspect direction but no effect in the slope direction.The SAI space is ploted in a graph taking zenith angle as constant and the varying angles of azimuth angle.

$$I_1(s,t) = a\cos(s) + b\sin(s)\cos(c_1 - t)$$

$$I_2(s,t) = a\cos(s) + b\sin(s)\cos(c_2 - t)$$

where, c_1 = azimuth$_1$, and c_2 = azimuth$_2$ and b = zenith.

c) Effect of Zenith Angle on Image PC

The zenith angle variation results in the change in the image intensity.The SAI space is ploted in a graph taking azimuth angle as constant and the varying angles of zenith angle. The zenith angle variation slightly alter the shape of the SAI surface.

$$I_1(s,t) = a_1 \cos(s) + b_1 \sin(s)\cos(c-t)$$
$$I_2(s,t) = a_2 \cos(s) + b_2 \sin(s)\cos(c-t)$$

where, c = azimuth, and b_2 = zenith$_2$ and b_1 = zenith$_1$

The normalization of the cross power spectrum is done by the taking the phase angle, $\emptyset(\omega,\varphi)$ from the image intensity.

$$\emptyset(\omega,\varphi) = \arctan\left(\frac{Q_I(\omega,\varphi)}{Q_R(\omega,\varphi)}\right)$$

where $Q_R(\omega,\varphi)$and $Q_I(\omega,\varphi)$are the real part and the imaginary part of $Q(\omega,\varphi)$, respectively. The phase congruency is applied to the normalized cross power spectrum with non maxima suppression for the feature extraction for image matching. The hysteresis threshold is then applied to extract accurate feature extraction of the images. Then the SURF feature extraction and matching algorithm is used for the matching of the images in the same size and scale.

B. ESTIMATION OF SCALE INVARIANCE AND IMAGE SHIFT

The SIFT algorithm is used to extract the SHIFT features from the images F_1 and F_2 and resize it.The steps are :

1) Scale – Space Extrema Detection

The original sigma and the octave can be modified.The first image in the first octave is created by interpolating the original one. The DoG pyramid is created with 9 levelsto increase the accuracy of the extracted feature pixel points of the input images F_1 and F_2.The Gaussian noise is added to the greyscale images of F_1 and F_2.

2) Keypoint localization

The keypoint localization is used to search each pixel in the DoG map to find the extreme point in each level and then the maximum value pixel points is ploted with the SIFT algorithm.

The Scale-Space Extrema Detection and the Keypoint localization helps to detect the maximum strong points in the image using the SIIFT matching.

4. RESULT AND ANALYSIS

The matching of the existing system shows many of the matching points with highest points feature extraction using the SURF algorithm.The algorithm works only on the same sized image with shifted and non sifted source image. The SURF algorithm points out the pixels having highest point values. In the proposed system SHIFT algorithm is used to match the point with accurate feature extraction.

Fig. 2. Matching in Existing system

Fig. 3. Matching in Proposed system

The existing system will work only on the shifted images using the SURF and PC algorithm and the estimated shift of the input image with the source image is 17. The proposed system uses the SIFT algorithm which works on both the shifted and resized images and the estimated shift of the input image with the source image is 12.

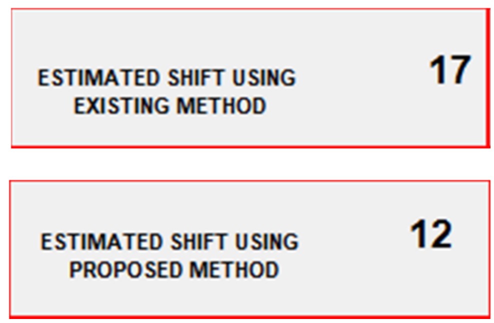

Fig. 2. Estimated shift of the input images in existing and proposed system

The error rate of the existing system is 70% and the proposed system is 20%.

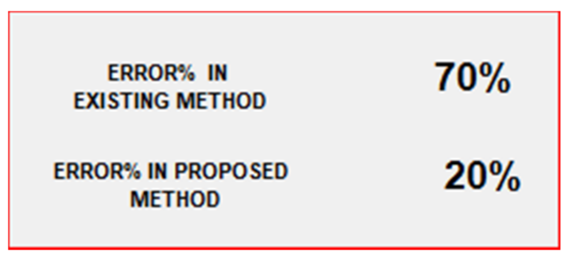

Fig. 3. The error rate of the existing system and the proposed system

5. CONCLUSION

Image matching techniques are used for tracking of copy right images and deduplication of images in remote sensing applications.The PC illumination robustness is used to find the unchanged spatial features or patterns under different lighting conditions.In the proposed method the SIFT algorithm is used along with the PC and SURF algorithm to improve the matching accuracy of the images and the 50% of error rate is reduced as result. The SIFT algorithm helps to find the scale invariance and shift occurred in the input image with the source image.

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