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فسيفساء الصور الفضائية بوساطة الواصف لتحويل الجيب تمام الرقمي

حميد مجيد عبد الجبار
قسم الفيزياء ، كلية التربية ابن الهيثم، جامعة بغداد

الخلاصة

في هذا البحث قدّمت طريقة لفسيفساء الصور الفضائية بوساطة الواصف لتحويل الجيب تمام الرقمي معدلة عن معيار الباحث عبد الكريم [1] للتشابه، اذ قدّمت طرائق جديدة لتسريع عملية الفسيفساء. قورنت النتائج المستحصلة من تطبيق الواصف لتحويل الجيب تمام الرقمي مع طريقة الفسيفساء باستخدام معيار التشابه جذر معدل مربع الخطاء RMSE، اذ اثبت طريقة الفسيفساء المعدلة بوساطة الواصف لتحويل الجيب تمام الرقمي هي طريقة سريعة ودقيقة.

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Satellite Image Mosaics Using Digital Cosine Transform (DCT) Descriptor

H. M. Abdul Jabar
Department of Physics,College of Education Ibn Al-Haitham, University of Baghdad

Abstract

In this research work, a modified DCT descriptor are presented to mosaics the satellite images based on Abdul Kareem [1] similarity criterion are presented, new method which is proposed to speed up the mosaics process is presented. The results of applying the modified DCT descriptor are compared with the mosaics method using RMSE similarity criterion which prove that the modified DCT descriptor to be fast and accurate mosaics method.

Introduction

Satellite image mosaics is essential preprocessing step to obtain a large view of the interest location from number of scenes that taken from one or different satellites, where each scene cover fragment of the complete view. The main obstacle in such task is to find criterion that can find the match locations in the different scenes in order to mosaics them, using the regular distance metric (like MSE, MAE, …) will not detect the similar location if any change happened in either locations, since the regular distance metric is variant for scaling, transition, flipping and rotation operations or if some kind of noise is present in the scenes, and it utilizes huge computation to find the matched location between two scenes.

Many researchers try to use other distance metrics that invariant to scaling, transition, flipping and rotation operations, where metrics that work in spaces other than the spatial domain are suggested such as Zhang and Lu [2], they try to use Fourier coefficients as descriptor shape-based image retrieval, they suggested to use the polar form of the Fourier transform and use the new domain coefficients as descriptors and use rational matching criterion to find the matching locations, where the matching criterion will be invariant to scaling, rotation and transition, The main obstacle in this criterion is that it is variant to flipping and every image should be convert to polar form before applying Fourier transform on it and it uses 36 features to decide if the two location matches or not, therefore it needs a huge computations.

While Polyakov *et al.* [3] uses Fourier descriptor to identify the objects boundary to classify the human signatures. Folkers and Samet [4] use the same Polyakov techniques but with one difference, they decompose the target shape to simple elementary shapes (rectangle, polygon, ellipse, and B-spline) then use its boundary. These algorithms can't be used for raster since it originally designed for boundary vector.

DCT Descriptor

Like other transforms, the Discrete Cosine Transform (DCT) attempts to decorrelate the image data. After decorrelation each transform coefficient can be encoded independently without losing compression efficiency. [5]

Nearly all forms of invariants, whether projective or not, involve ratios. By constructing ratios, even if one quantity changes under a transformation, as long as another quantity changes proportionally under the same transformation, their ratio stays the same. [6]

$$F = \frac{Coff\,(a,b)}{Coff\,(c,d)} \qquad \text{………………..………………… (1)}$$

Where a, b, c, and d are the coefficient location, Abdul Kareem [1] in his thesis presents a new method to find the similarity between two slid windows using DCT coefficients as descriptors, he uses the following rational equation to achieve the similarity metric invariant for scaling, translation, rotation, flipping and noise addition.

$$F_{i,j} = \left| \frac{DCT(i,j)^2 - DCT(j,i)^2}{DCT(i,j)^2 + DCT(j,i)^2} \right| \qquad \text{…………………..…… (2)}$$

the coefficients pairs [DCT(0,1), DCT(1,0)], [DCT(0,2),DCT(2,0)], and [DCT(1,2),DCT(2,1)] are used individually, and compare the time that each pair need to find the match slide window for fractal compression purpose.

New DCT Descriptor

One of the DCT properties is the energy compactness; it has the ability to pack input data into as few coefficients as possible near the DC coefficient (left top corner). Using coefficients pairs with high energy compactness in the Abdul Kareem DCT descriptor equation (eq. 2) will give better results in the match process.

In this research work, a developed DCT descriptor criterion had been made based on the Abdul Kareem method, where in the new DCT descriptor equation more than one DCT coefficient pair are involved, but with maintaining the property that the coefficient that closer to the DC coefficient has higher energy, this has been done by giving each F factor exponent increase with its distance from the DC coefficient. Using more than four F factors (DCT coefficient pairs) is not recommended since the value of the F factor will be very small when the exponent is larger than four as illustrated by.

$$F = \sum_{i=1}^{4} F_i^i \qquad \text{…..…………………………………… (3)}$$

Research Procedures

The images that view the International Airport, Baghdad, Iraq used to mosaics and form the fall view; the images were collected multispectral image using IKONOS figure (1), four pairs of the DCT coefficients are used in eq. 3 which are [DCT(0,1), DCT(1,0)], [DCT(0,2),DCT(2,0)], [DCT(0,3),DCT(3,0)], and [DCT(1,2),DCT(2,1)] therefore eq. [3] become in the following form:

$$F = F_{0,1} + F_{0,2}^2 + F_{0,3}^3 + F_{1,2}^4 \qquad \text{……………………………… (4)}$$

To speed up the matching process, the F factor for the two images is calculated in advance for each slide window and taking the lowest difference between the F factors of the two images as the matched windows. Beside that, the effects of calculating the DCT transform using the waveform method [5] which calculates the DCT transform faster than the regular way, this method is called in this research the fast new F factor method.

Results and Discussions

Scenes that cover the Baghdad International Airport, Baghdad, Iraq captured using IKONOS satellite figure (1), are used to evaluate the new F factor method (the regular and fast way) it is compared with the root mean square method (RMSE) by calculating the total time needed to find the matched slide window between the two images to mosaics the complete view using different sizes for the slide window, figure (2). The RMSE record the highest computational time compared with the other methods and it has inverse relationship with the slide window size because it will reduce the number of windows that are needed to exam, while the new F factor records computational time less than the RMSE method but it has forward relationship with the window size because when window size increases the computation time to calculate the DCT transform is increased exponentially, the two method intersect at window size equals to 25 pixel. The fast new F factor, as shown in the figure (2),

does notnave any effect with the changing of the size of the slide window and records the lowest computational time for all methods.

Since the total computational time to find the match window is vary from set image to mosaics to another, therefore another criterion used to show the results which is invariant to changing the images set and it is illustrated in figure (3). The new criterion is time needed to complete the search for one slide window (time per window) and it is calculated by dividing the total computational time by the number of the examined windows until finding the matched window.

The behavior for the new F factor (the regular and the fast way) is the same, but for the RMS mosaics method the behavior is changed where the computational time per window has foreword relationship with the size of the slide window instead of the inverse relationship for the total computation time.

Conclusions

From the results that obtained by applying the new F factor methods, the following conclusions are driven:

- The F factor method is invariant to the scaling, translation, rotating and flipping operations, which will be more accurate to calculate the similarity to mosaics different images.
- Participating the F factors of other DCT coefficients in the calculation of the final F factor and giving each of them weight according to its energy pickiness ability (equation 3) is more reliability than using F factor for one pair with regarding to its energy pickiness ability.
- Using the new F factor criterion with satellite images as similarity measurement is recommended because it is faster than the other criteria and more accurate.
- The computational time for the F factor (the regular way), is very sensitive to the size of the slide window after 25 pixels.
- The fast way is recommended to be used to mosaics the satellite images because it is very fast and invariant to the size of the slide window.

References

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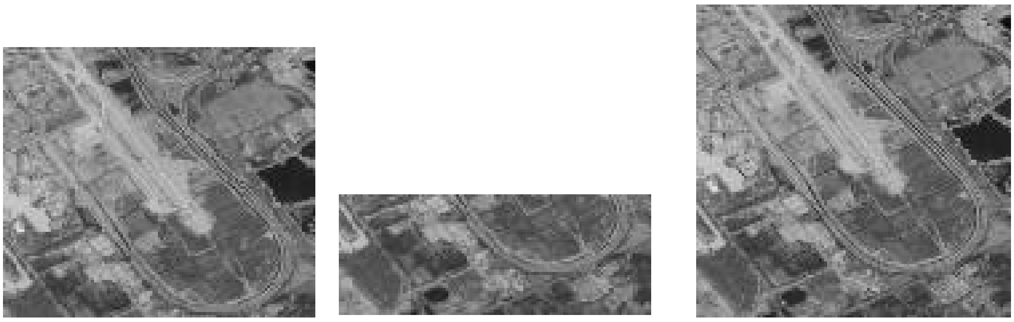

a   b   c

Fig. (1) The scene of Baghdad Internationals airport a) first view b) second view c) the merged complete view

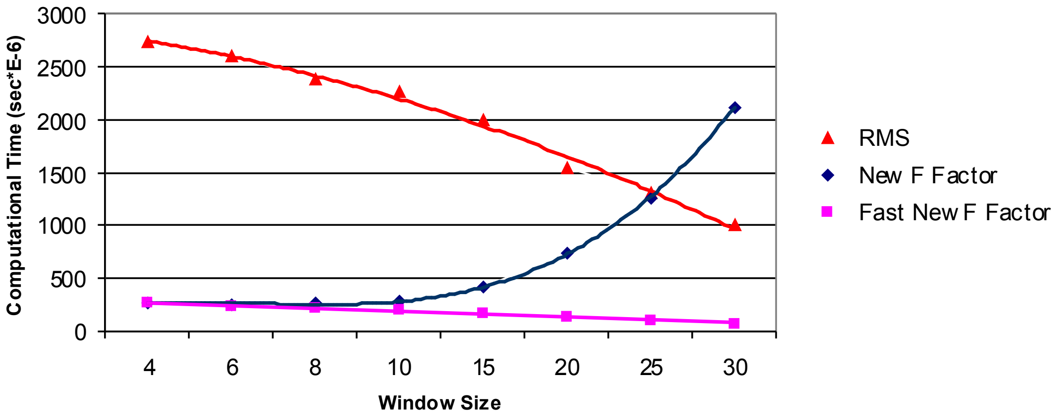

Fig. (2) The total computational time to find the match window for the three methods

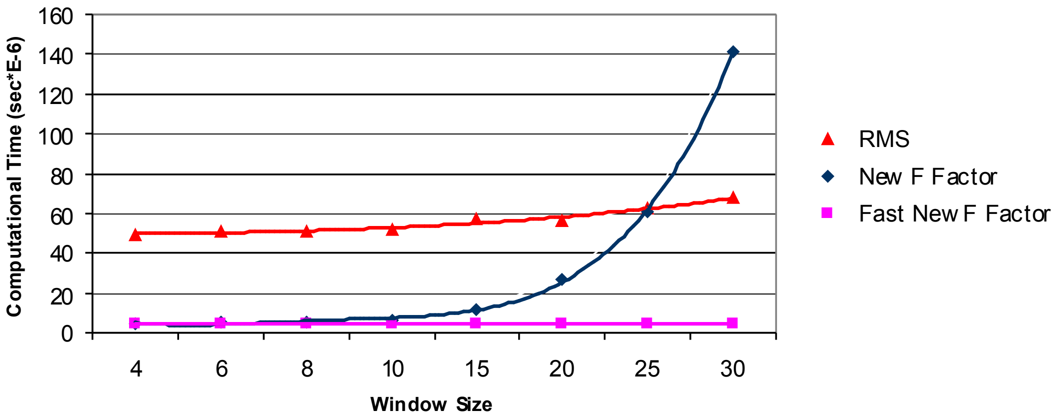

Fig. (3) The computational time needed to complete search one window for the three methods