An Iteration Restoration Technique Of An Image Sequence

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Abstract:
This paper presents a new iterative Image Restoration based on the least-Square method. Based on adaptive this filtration algorithm is focused on transformation the given restoration model from the spatial domain to the Fourier domain. This implementation of derived models needs less storage capacity and far less time in execution. Also in this paper present ANew three Step Search for motion estimation technique (NTSS).In this paper two goal have been achieved, once obtained a restored image without adopted restoration technique on it (B-frame), also achieved a good rate of compression ratio by adopted motion estimation technique.

Keywords: Video Restoration, Fourier transformation, Motion Estimation, point – Spread- function, iteration restoration.

تقنية ترميم تكرارية لصور متعاقبة

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الخلاصه
في هذا البحث اعتمدنا تقنية مطوره ترتكز على مبدأ معيار التربيع –الأصغر أساسا لها لتقدير أفضل صوره مرممه. نفذ هذا المرشح على علاقات رياضيه مشتقه ,تعتمد تحويلات فوريه لتمثيل العلاقات المعطات في المجال الترددي . يسهل عملية تطبيق العلاقات المصاغه في المجال الترددي في زيادة سرعة تنفيذ التقنية والتقليل من حجم البينات المعتمدة في مثيلاتها من الصيغ المنفذة في المجال الفضائي.في هذا البحث أيضا تم تقديم طريقة جديدة ثلاثية الخطوه لتخمين الحركة في هذا البحث حصلنا على هدفين في ان واحد ,الاول هو الحصول على صوره مرممة بدون إجراء عليها تقنية الترميم وكذلك حصلنا على نسبه ضغط جيدة من خلال تطبيق تقنية تخمين الحركة.

Introduction

Signal restoration—linear deblurring and noise suppression is widely treated in the literature for a variety of applications Single image restoration has become a classic chapter in image processing theory, with a direct generalization to the restoration of continuous image sequences [1,2], Image sequence restoration takes a crucial place in several important domains. In biology, confuse microscopes provide noisy image sequences due to the limited number of photons. In astronomy, the same phenomenon occurs in telescopes and image sequences are also corrupted with an important noise level. In medicine, image sequence denoising is critical especially in ultra-sound and X-ray imaging. Video surveillance also provides some noisy image sequences. Finally, we can notice that the noise increases the required bandwidth for video sequence

broadcasting and that a denoising algorithm can then produce a more compact image sequence digital representation [3].

Iterative image Restoration based on the Least- Square method:-

For an optical imaging system, with spatially varying point-spread-function (PSF), the output image can be represented by [1]:

$$g(x,y)=\int_{-\infty}^{\infty}\int h(x,y,\bar{x},\bar{y})\circ \mathrm{f(x,y)}\overline{\mathrm{dx}}\,\overline{dy}+n(x,y)..(1)$$

Where h(X,Y;X,Y), f(X,Y), n(X,Y) are, respectively, the (PSF), original object function, and the noise function.

If the object function is sampled into NxN matrix, then eq.(1) can be written in the following matrix form[1]

g= [H]f+n ……..(2)

Where g,f, and n are columns vectors having N^2 elements, while [H] is a matrix, of N^2x N^2 size, characterizing the (PSF).

In case if the noise is neglected, an iterative solution to the eq. (2) above is given by the Van Cittert successive convolution method, written as [2];

$$f^k=f^{k-1}+\alpha[D]^{-1}[g-[H]f^{k-1}].....(3)$$

Where f^k is the estimate of f in k iteration, [D] is a diagonal matrix whose diagonal elements are the same as those of matrix [H], and is an acceleration parameter with an attenuator $[D]^{-1}$.

Before proceeding more, let us define the following useable functions;

$[H]= W [D] W^{-1}$ ……(4)

Or, alternatively;

$[D]= W^{-1} [H] W$ ……(5)

Where W^{-1} is the Fourier transform's kernel, its (i, j) element is given by;

$$W^{-1}(i,j)=\frac{1}{N}e^{\left[-\sqrt{-1}\frac{2\pi}{N}ij\right]}..... .....(6)$$

While its inverse is given by:

$$W(i,j)=\frac{1}{N}e^{\left[-\sqrt{-1}\frac{2\pi}{N}ij\right]} \quad ……(7)$$

Therefore; the Fourier transform can be represented by;

$$W^{-1}f(x,y)=F(u,v)..... .....(8)$$

Taking in our consideration the above notation, eq. (3) can be Fourier transformed, by multiplying both of its sides by W^{-1}, i.e;

$$W^{-1}f^k=W^{-1}f^{k-1}+\alpha[D]^{-1}[W^{-1}g-W^{-1}[H]f^{k-1}].....(9)$$

In the frequency domain, the above equation is written as;

$$F^k(u,v)=F^{k-1}(u,v)+\frac{\alpha}{H(u,v)}[G(u,v)-H(u,v)F^{k-1}(u,v)]$$

……(10)

Motion Estimation and Compensation

Successive video frames may contain the same objects (still or moving). Motion estimation examines the movement of objects in an image sequence to try to obtain vectors representing the estimated motion. Motion compensation uses the knowledge of object motion so obtained to achieve data compression. In interframe coding, motion estimation and compensation have become powerful techniques to eliminate the temporal redundancy due to high correlation between consecutive frames [4].

There are two mainstream techniques of motion estimation: pel-recursive algorithm (PRA) and block-matching algorithm (BMA) .in this search we was produce the(BMA) [6]. **frame** Figure .2 illustrates a process of block-matching algorithm. I

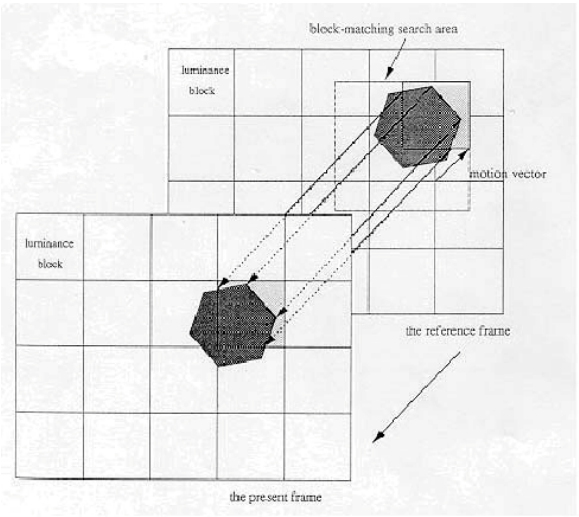

Figure 1- Illustrates A Process Of Block-Matching Algorithm.

There are various cost functions, of which the most popular and less computationally expensive is
Mean Absolute Difference (MAD) given by equation (11). Another cost function is Mean Squared Error (MSE) given by equation (5).
The Mean Absolute Difference (MAD), defined as :

$$MAD(dx,dy)=\frac{1}{mn}\sum_{i=-n/2}^{n/2}\sum_{j=-m/2}^{m/2}F(i,j)-G(i+dx,j+dy)$$

……(11)

Where F(i,j) represents an (m×n) macro block within the current frame, G(i,j) represent the corresponding macro block within reference frame (past or future), (dx,dy) a vector representing the search location[3,7] .
The Mean-Squared Difference (MSD) cost function is defined as :

$$MSD(dx,dy)=\frac{1}{mn}\sum_{i=-n/2}^{n/2}\sum_{j=-m/2}^{m/2}[F(i,j)-G(i+dx,j+dy)]^2$$

……..(12)

New Three Step Search (NTSS) For Motion Estimation:

NTSS [4] improves on TSS results by providing a center biased searching scheme and having provisions for half way stop to reduce computational cost. It was one of the first widely accepted fast algorithms and frequently used for implementing earlier standards like MPEG 1 and H.261The TSS uses a uniformly allocated checking pattern for motion detection and is prone to missing small motions. The NTSS process is illustrated graphically in Fig 4. In the first step 16 points are checked in addition to the search origin for lowest weight using a cost function [7]. Of these additional search
Locations, 8 are a distance of S = 4 away (similar to TSS) and the other 8 are at S = 1 away from the search origin. If the lowest cost is at the origin then the search is stopped right here and the motion vector is set as (0, 0). If the lowest weight is at any one of the 8 locations at S = 1, then we change the origin of the search to that point and check for weights adjacent to it. Depending on which point it is we might end up checking 5 points or 3 points.. The location that gives the
lowest weight is the closest match and motion vector is set to that location. On the other hand if the lowest weight after the first step was one of the 8 locations at S = 4, then we follow the normal TSS procedure. Hence although this process might need a minimum of 17 points to check every macro block, it also has the worst-case scenario of 33 locations to check [8].

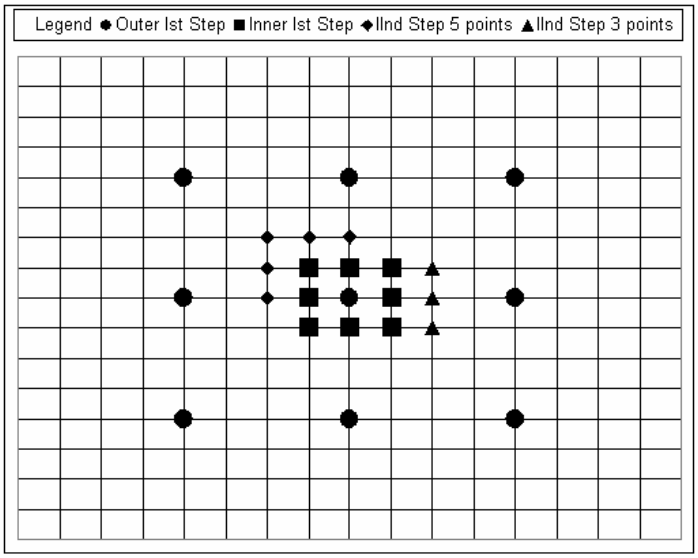

Figure 2- New Three Step Search Block Matching: Big Circles Are Checking Points In The First Step Of TSS And The Squares Are The Extra 8 Points Added In The First Step Of NTSS. Triangles And Diamonds Are Second Step Of NTSS Showing 3 Points And 5 Points Being Checked When Least Weight In First Step Is At One Of The 8 Neighbors Of Window Center.

Frame Types

The basic principle for video compression is the image-to-image prediction. The first image is called an I-frame and is self- contained, having no dependency outside of that image. The following frames may use part of the first image as a reference. An image that is predicted from one reference image is called a p-frame and an image that is bidirectionally predicted from two reference images is called a B-frame.

- I-frames : Intra predicted, self-contained.
- P-frames : Predicted from last I or P reference frame.
- B-frames : Bidirectional; predicted from two references one in the past and one in the future, and thus out of order decoding is needed.

The video decoder restores the video by decoding the bit stream frame by frame. Decoding must always start with an I-frame, which can be decoded independently, while P- and B- frames must be decoded together with current reference images [5,7,8].

Figure 3- Illustration above how atypical sequence with I-,B-,and p frame may look. Note that a p-frame may only reference a preceding I-or P-frame while a B-frame may both proceeding and succeeding I-and P-frames.

IBP Frame Model

The IBP frame model is a new feature of video coding .It is consists of three picture (one I-picture and B-picture) and the P-picture are predicted from previous decoded(I).The B-picture are by directionally predicted both from the previous decoded (I) and P-picture .This B= I + p/2.

Experimental Result:

In this paper, an Adaptive iterative Image Restoration based on the least-Square method. This technique was applied to gray woman, the image size (128x128) we was found from the experimental result the good reconstruction image with good value of PSNR .We will show the usefulness of the motion estimation in interframe compression. The Restoration technique and motion estimation are performed using the visual basic. In performance tests of the proposed algorithm apply an iterative image restoration(AIIRT) and New Three Step Search (NTSS) for motion estimation.

The figure (4) represent the origin sequence (woman) images. Figure (5) represent the sequence blued image figure(6) represent the reconstruction (I), (p) frame when we apply (AIIRT) technique. Figure (7) represent reconstruction images (I) and (P) and block different when we apply (NTSS) used (MAD) criteria with thr.4, in figure shown the block different between (I),(P) frames . Figure (8) represent reconstruction images (I) and (P) when we apply used (MSD) criteria with thr.4, in figure shown the block different between (I),(P) frames . Figure (9) represented the frames (I), (B1)and (P) respectively WhereB-pictures are bidirectional predicted both from the previous decoded (I) and P-picture . Table (1) numerical result when we apply motion estimation (NTSS) with different criteria (MAD) and (MSD)

Figure 4- Represents The Origin Sequence (Woman) Images.

Figure 5- Represent The Sequence Blurred Images.

Figure 6- Represent The Reconstruction (I), (P) Frame When We Apply (AIIRT) Technique

Figure 7- Represent Reconstruction Images (I) And (P) And Block Different When We Apply (NTSS) Used (MAD) Criteria With Thr.4

Figure 8- Represent Reconstruction Images (I) And (P) When We Apply Used (MSD) Criteria With Thr.4.

Figure 9- Represented The Frames (I), (B1)And (P) Respectively Whereb-Pictures Are Bidirectional Predicted Both From The Previous Decoded (I) And P-Picture.

Table 1- Numerical Result When We Apply Motion Estimation (NTSS) With Different Criteria (MAD) And (MSD)

threshold	Tim of search(sec)	No. of block change	Over all comp. ratio	PSNR (B1)	PSNR (B2)	PSNR (P)
4 (MAD)	0.411	92	1.4	20.7	20.4	21.2
8 (MAD)	0.232	81	1.45	20.7	20.4	21.2
12 (MAD)	0.161	56	1.67	20.7	20.4	21.2
4 (MSD)	0.411	61	1.79	20.3	20.1	20.9
8 (MSD)	0.232	46	1.83	20.3	20.1	20.9
12 (MSD)	0.161	39	1.85	20.3	20.1	20.9

3. Conclusions:

From the result we were found best image reconstruction at good value PSNR from result we have a frame (B) restored without apply on it restoration technique by apply motion estimation technique and interpolation technique, then, we have obtained a good value of compression ratio by way. We have presented motion estimation technique, New Three Step Search (NTSS), The experimental results show that this new method can significantly reduce the computational complexity and low search time while achieving comparable performance for many video sequences . Also we have found the criteria (MAD) was gave higher number of block different than criteria(MSD) then low C.R when we used(MAD) than (MSD).Threshold (4) was gave highest number of block different than other thresholds.

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