Study on the Noise Removal Processing of TV Picture at High Speed

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Summary
This paper proposes a motion estimation method using the position estimation method of TV noise for motion picture restoration. On the basis of the block-matching used in the past, a new method is developed. The motion of the picture between the frames is calculated by the mean vector and the search position the search center was moved is corrected by the approximated value. The method was verified useful in this study.
Key words:
block matching, motion estimation, mean vector

1. Introduction

China has a vast terrain, there is TV receiving the signal unstable regions. In addition, affected by the TV around the home appliances, television image is noisy compared to the situation in general. Additionally, with the big screen and 3D television into the home, a television image in the presence of noise becomes more conspicuous. Television image denoising must be immediate.
Noise removal is a commonly used means of spatial filtering method and the dual axis direction of the ternary space filtration method, the means to achieve denoising purpose, but can not be repaired to avoid the negative portrait of the phenomenon of blurring can not be expected to obtain repair effect. Information so you can consider using vintage video of the large snowflake-like noise removal algorithm for point, the image of the frame correlation between the noise does not have the lock, and with noise corresponding to part of the previous frame or a frame image after the corresponding replacement parts to achieve the purpose of Noise. Noise is characterized by means of this to ensure removal of noise, but the large amount of computation, if the TV image denoising operation when used in real-time processing can not guarantee the existence of the problem.
Based on this, the research problem to be solved is to ensure that the noise removal can be achieved under the premise of real-time repair process in order to carry out future IC chip equipped television to provide a theoretical basis. Improvement of the specific algorithm is used to explore the position correction, the implementation of exploration to determine the timing, noise removal and other block matching method to determine timing of high-speed, accurate processing, to carry out experiments and performance analysis.

1.1 Vintage video noise removal method snow blocks been used in feasibility

(ⅰ) TV Image Noise Characteristics

- Lateral movement of the thread-like to do highlights.
- Bottom-up movement of the band spot.
- Shake the whole image (see less).

(ⅱ) TV Image Band Noise and Block Noise from Vintage Tape Similar Snow

- Randomly generated.
- The occurrence of two kinds of noise, location of the image for each frame is independent, does not have the time axis direction correlation.
- The occurrence of noise and its position is usually different from the surrounding brightness values.

Based on the above characteristics, these two types of noise using the same method of noise reduction is feasible.
Snow black or white noise to block the majority, and a number of multi-frame images in time up to 5% of the noise, the visual effect is not obvious. In addition the location of the noise is random, does not have the time axis direction correlation. In addition, the direction of moving images on their own time, highly relevant, therefore, consider using the same method to remove the belt noise.

1.2 Band noise removal method

The object of this study is the dynamic image, dynamic image is composed of many image frame by frame combination. When the dynamic search method BM (block matching) method can be applied.

(ⅰ) Improvement of Noise Removal Performance

- Images and objects around the frame between frames for dynamic image processing, using BM method.
- Base d on 1) the dynamic movement to determine the amount of income, to identify the object before and after

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the frame image with the relative position of two images, the implementation of the middle filter method (MF)
BM method by the above two processes.

(ii) Past the BM Method Based Denoising Methods and Problems

・BM method
The average of the past BM method is often used, but the average method for the detection of noise and dynamic ribbon determine the failure cases more. Band noise than their brightness values around some large, containing the pixel noise error is considered to be the absolute value of deviation from the experimental setting. Therefore, the average absolute value of the block is also considered deviations from the correct decision can not be achieved dynamically.
Using BM method, the value of dramatic changes in luminance area that is noise, which determine the way to do the whole full-frame image retrieval, naturally there will be enormous computational deficiencies.
・BM calculation
Now, the dynamic is often determined by the BM approach is to target the frame image is divided into E × E of the block, in blocks for dynamic search and dynamic determination. Reference frame the same position as the central image, within a certain range (± P) the corresponding minimum error block retrieval. Now set the image frame n, with reference to frame the image, compared with n-1. n in a position x, the value of brightness is In (x), x the pixel location and reference frame image from the displacement of that position is set to d, then moved the position x + d of the pixels of the absolute error (AE) can use equation (1) said.

$$AE(x,d) = |In(x) - In\text{-}1(x+d)| \qquad \text{--------（1）}$$

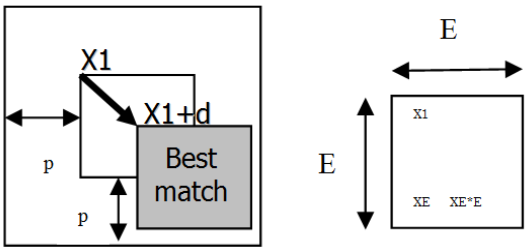


Fig. 1 About BM

Function that is called the block error analysis functions. Over the past BM (average BM) analysis of the function can be expressed as follows. (N: number of pixels within the block E × E).

$$MAE(d) = \frac{1}{N}\sum_{i=1}^{N} AE(x_i, d) \qquad \text{--------（2）}$$

1.3 To Do With the BM Method to Determine

Of noise removal, the first frame image is divided into N × N small blocks, a frame of reference for the field of image and the frame around the image relative to its corresponding position to do with the BM method to determine, as the first process, that is, dynamic decision process. The second process is the so-called dynamically determined based on the object frame before the frame image and its corresponding position image map together, the timeline on the direction of filtering, also known as the filtering process. Also, filtering processing is embedded in the normal image noise, only the noise part of the detection, treatment.

2. Suitable for High-speed Removal of the BM Strip Method of Noise

To achieve high-speed processing, the location of the study, the search and retrieval of the implementation of amendments to deal with two schemes to determine.

2.1 The Amendment to Retrieve Location

・The average application and principles of dynamic displacement
Calculate the dynamic displacement of the frame image, retrieving center shift along the displacement, as amended position on the search.
・The amendment to retrieve the position
Image for the movement along the frame just behind the location of fine-tuning. This correction method to retrieve the location of the former a dynamic image obtained average displacement of all images, and do according to all the moves from the displacement. This approach can make the search to determine rate and high-speed processing.(Figure 2 Dynamic displacement (indicative) and Figure 3 Dynamic displacement (Example) said.).

Fig. 2 Indicative

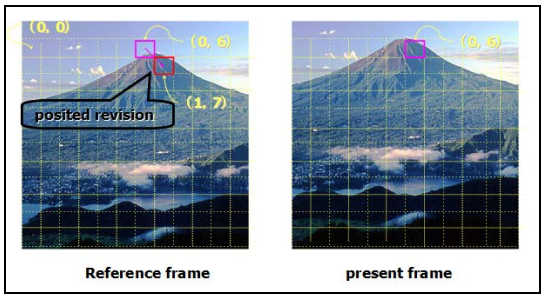
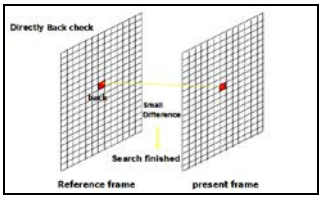


Fig. 3 Example

Shown in Figure 3, in the timeline on the direction of two successive frames represented by the image. In both images in the frame, all in the mobile landscape. Frame images are small and are behind the pink light pink small frame image comparison, the peak position of the movement has occurred, the location must be amended.
In the first exploration, the average of all images obtained with reference to the dynamic displacement, the number of amendments with the obtained search to determine the location and retrieval.

2.2 The Implementation of the Decision to Retrieve

In order to achieve real-time processing, the dynamic part of the high-speed retrieval were studied. A high-speed processing method is implemented when the low matching search processing. This authentication feature is used to find matching to achieve, rather than view the difference.
Difference is small, no need to retrieve the exit. (Figure 4 Dynamic Search (small difference))
When a large differential dynamic retrieval is behind the image reference frame is determined as the center within the range of ± 5, retrieve the corresponding difference be the smallest block. (Figure 5 Dynamic Search (big difference))



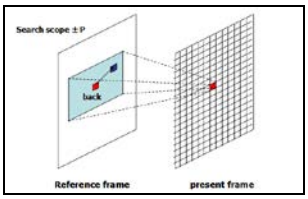
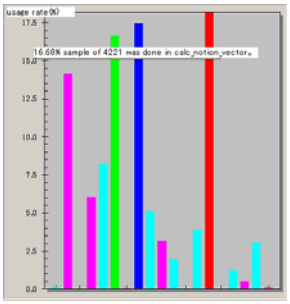


Fig. 4 Small difference Fig. 5 Big difference

3. Simmulation

3.1 Displacement of the Average Processing

By this method will enable a substantial increase in processing speed. In this study, VtuneTM results obtained in Figure 6, Figure 7, the most time-consuming processing of dynamic retrieval, using the key position correction means to obtain good results.
The figure of the [hot spot report] is the implementation of the internal CPU utilization when API said the time spent part of the map are listed. Icon in the address, function, or among other units conversion program, said. Map colors to red, blue, green CPU utilization in order to identify the level of order, followed by the color, purple. In other words, from Figure intuitive point of view, as long as the lower red, blue, and green, said part of the ratio, the implementation of performance will be improved. The figure is the dynamic retrieval calc_motion_vector handler function, the algorithm uses the test results prior to 16.68% for the green, but turned to purple by 2.45%. In other words, the function of the CPU utilization decreased significantly shorten the processing time.
Dynamic retrieval processing speed, and experiments confirmed that each frame moving image retrieval time can be reduced to 15.5ms, reduced time spent than in the past nearly 4 times.



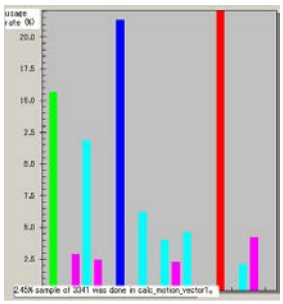


Fig. 6 Unprocess result Fig. 7 Processed result

3.2 Reduce the Computational Processing

Contained in the actual noise in television images, is basically composed of luminance values (Y) image, so you can only (Y) for processing and comparing to do performance comparison. Type 3 is the luminance value (Y) is calculated:

$$Y = 0.299R + 0.578G + 0.114B \quad \text{--------- (3)}$$

Color image from red (R), green (G), blue (B) composed of three colors, their intensity can be from 0 to 255 with 8-bit

binary number to said color television broadcast in the past exactly the same, only (Y) component, color difference components U, V is the mass contained in the waves, this study used only the Y and omitted the U, V are two components. So that, the computation is reduced.

4. Conclusion

The research results in the emphasis on the premise of moving image restoration, the repair rate increase proposed by the new algorithm, so that each frame image retrieval time reduced to 15.5ms, achieve real-time processing. And significantly improved image quality repair, denoising rate of 95%, and the error repair is low. The next step of this algorithm is to form a hardware IC, embedded into the TV, applied to practice. However, in order to achieve real-time processing, migration to reduce the computational hardware and technology to further increase processing speed of the research will continue.

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