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SURVEY ON MOTION ESTIMATION BASED ON BLOCK MATCHING ALGORITHM

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Abstract

Motion estimation is an significant segment in video coding. Many ME process have been there to reduce the complexity of video coding. One of the useful processes is block matching process. There were so many algorithms for BM process. This paper is a survey of some of the block matching algorithm. The comparison is based on the searching points, and the PSNR (Peak-Signal-to-Noise-Ratio) values.

Keywords: Motion Estimation, Block Matching, PSNR, Video coding, searching points

1. Introduction

A video comprises of multiple number of frames. The redundant information in the video should be eliminated, for that video compression is needed. Motion Estimation is significant to compress a video. So many techniques are there in ME, one of the useful techniques is Block matching. In a BM process a video is divided into multiple numbers of frames and then the frames are divided into equal size non-overlapping blocks. Each block in the current frame the suitable matching block is identified from the previous frame. In that BM process several algorithms were proposed.

2. Block Matching Algorithm

A video is converted into multiple numbers of frames; each frame is divided into equal size non-overlapping macro blocks. Then apply block matching algorithm. (E.g. Full Search Algorithm, Diamond Search Algorithm ,etc,)Finally estimate the motion.

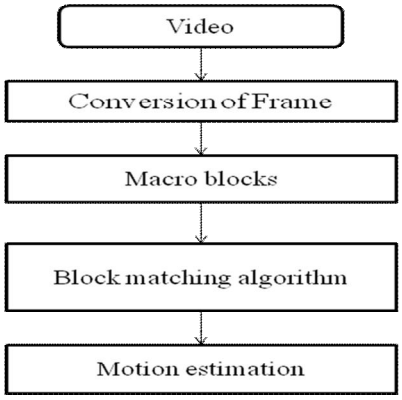

Fig 1 Block Matching Process

In Fig 2 the marked block in the current frame is compared with the blocks in the previous frame. Best matching block is identified in the reference frame within the search area.

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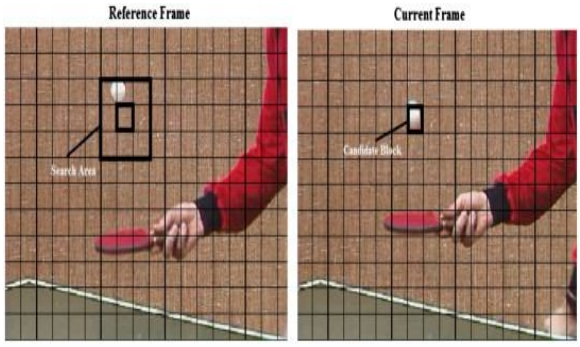

Fig 2 finding the matching block

2.1 Full Search Algorithm (FSA)

FSA is a simple and efficient block matching algorithm .it will give accurate solution because it will compare each block in the current frame with all other blocks in the previous frame. It is also called as Exhaustive Search. It will give an optimal result.FSA is one of the best algorithm but it is computational expensive. If displacement is 7 then FSA will compute cost for 225 macro blocks. So that more efficient algorithm is needed with less search points.

2.2 Three Step Search (3SS)

This algorithm is based on a course-to-fine approach. Because of its simple and robust performance it became a very popular method. The initial step size is half of the maximum motion displacement d

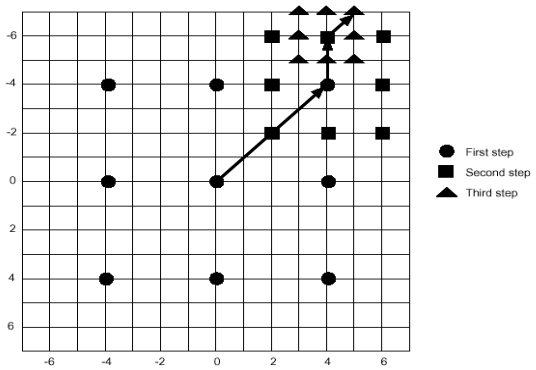

Fig 3 Three Step Search

For each step, nine checking points are matched and the minimum BDM point of that step is chosen as the starting centre of the next step. For d = 7, the number of checking points required is (9 + 8 + 8)=25. For larger search window (i.e. larger d), 3SS can be easily extended to n-steps using the same searching strategy with the number of checking points required equals to [1 + 8 log2(d + 1)]. One problem that occurs with the three step search is that it uses a uniformly allocated checking point pattern in the first step. This will be inefficient for small motion.

2.3 New Three Step Search (N3SS)

In N3SS additional 8 neighbour checking points are searched in the first step of N3SS as shown in Fig 4. Figure shows two search paths with d = 7.

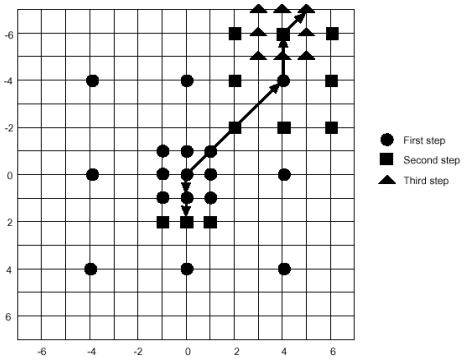

Fig 4 New Three Step Search

The centre path shows the case of searching small motion. In this case, the minimum BDM point of the first step is one of the 8 neighbour checking points. The number of checking points required is (17 + 8 + 8) =33.

2.4 Four Step Search (4SS)

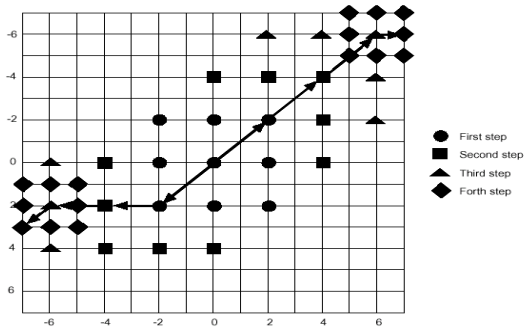

Fig 5 Four Step Search

4SS also exploits the center-biased characteristics of the real world video sequences by a smaller initial step size comparing in 3SS.The initial step size is fourth of the maximum motion displacement d (i.e. d/4). Initial step size is small, for that the 4SS algorithm needs four searching steps to reach the boundary of a search window with d = 7. Figure 6 shows two search paths of 4SS for searching large motion. The left path is requires (9+5+3+8) =25 checking points. The right path is requires (9+5+5+8) =27checking points in the worst case of the algorithm for d = 7.

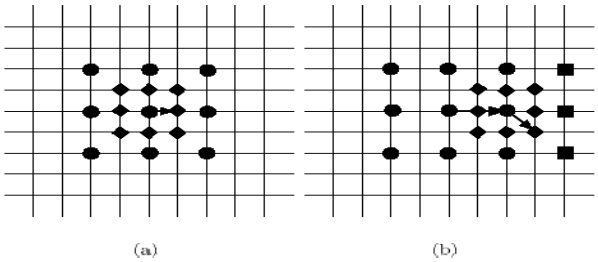

Fig 6 two search paths of 4SS

Fig 6 shows two search paths of 4SS for searching small motion. For the left path is requires (9 + 8) = 17 checking points. For the right path is requires (9+ 3+ 8) =20 checking points. As shown in Fig 6 there are either three or five checking points required in the second or third searching step. Moreover, if the minimum BDM checking point of that searching step is the centre one, the step size is reduced by half and jump to the forth step.

If the step size of the forth step is greater than one, then another four-step search is performed with the first step equals to the last step of the previous search. The number of checking points required for the worse case is (18 log2 [(d+1)/4] + 9).

2.4 Diamond Search (DS)

Diamond Search algorithm takes a diamond-shaped search pattern. The two fixed types of search patterns used in DS algorithm. It has two types. Type one is- large diamond search pattern (LDSP) .it is having nine searching points. Second type is small diamond search pattern (SDSP). It is having five checking points. The number of searching point required is 13.

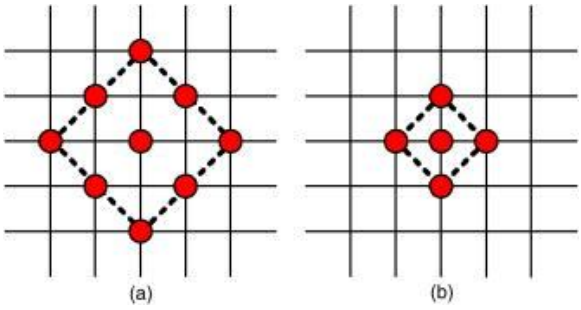

Fig 7 (a) Large diamond search pattern

(b) Small diamond search pattern

Step 1: For the initial LDSP, the centre is at (0, 0), and the nine search points of LDSP are tested. If the minimum block distortion (BDM) point is present at the centre, then go to Step 3; otherwise, go to Step 2.

Step 2: The minimum BDM obtained in the previous step is re-positioned as the new centre point to form another LDSP. If the new BDM point found is located at the centre position, then go to Step 3; else, recursively repeat this step.

Step 3: The search pattern is switched from LDSP to SDSP. The final result of the motion vector (MV) is obtained by minimum BDM point found in this step. This MV points to the best matching block.

2.5Artificial Bee Colony (ABC)

Food source positions, nectar amount and different honey bee classes are the three different components in ABC algorithm. Feasible solution is given by the food source position. The quality of the food source is understood by the nectar amount of the food source. Each bee classes generating a new food source positions The ABC algorithm in BM process estimating the motion with less search points.

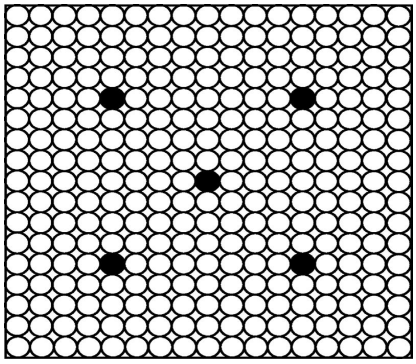

Fig 10 Initial search points of ABC

Step 1: First it will randomly select five search locations.

Step 2: Compute the fitness values for each search location

Step 3: Generate new search locations within the neighbourhood of its present position.

Step4: Compute fitness values for each individual by using the fitness calculation.

Step 5: If the new solution is better than the old solution then that will be replaced by the new solution otherwise the old solution remains.

Step 6: If the number of target iterations has been reached in the search window then that will be the final solution otherwise go back to Step 3.

ABC uses a simple fitness calculation using Nearest Neighbour Interpolation (NNI) algorithm.

3. Comparison of the Algorithms

(a) (b)

Fig 11 (a) akiyo (b) foreman

First, all algorithms compared based on the search points .secondly it's compared based on PSNR value.

Akiyo and foreman are the two input videos used for the testing. The videos are implemented in the above algorithms and the number of visited search points is found from each algorithms. Table 1 shows the number of visited search points. Table 2 shows the PSNR value for each algorithm using the videos.

Table 3 Advantages and disadvantages of all the algorithms

BM Algorithm	Advantage	Disadvantage
FSA	Best picture quality, highest PSNR value	Computational cost is very high
3SS	Optimal performance ,less complexity	Can't detect the small motion
4SS	Initial step is reduced for capturing the small motion	More complex than 3SS
N3SS	More efficient for small motion	More complex than 3SS
DS	Image quality can be reconstructed, and it averages the number of search points.	Computation is high

Table 3 shows the advantages and the disadvantages of the algorithm compared with other algorithms.

4. Conclusion

Motion estimation has used in various applications like video telephony, HDTV, etc. Block Matching Algorithms are the simplest and useful method for motion estimation. Here some of the algorithms were explained according to the search points and the PSNR values. All the algorithms are having their own advantages and disadvantages.

REFERENCES

[1] J.R. Jain, A.K. Jain, *Displacement measurement and its application in interframe image coding*, IEEE Transactions on Communications COM-29 (December)(1981) 1799–1808.

[2] H.-M. Jong, L.-G. Chen, T.-D. Chiueh, *Accuracy improvement and cost reduction of 3-step search block matching algorithm for video coding*, IEEE Transactions on Circuits and Systems for Video Technology 4 (February) (1994) 88–90.

[3] R. Li, B. Zeng, M.L. Liou, *A new three-step search algorithm for block motion estimation*, IEEE Transactions on Circuits and Systems for Video Technology 4(August (4)) (1994) 438–442.

[4] L.-M. Po, W.-C. Ma, *A novel four-step search algorithm for fast block motion estimation*, IEEE Transactions on Circuits and Systems for Video Technology 6(June (3)) (1996) 313–317.

[5] S. Zhu, K.-K. Ma, *A new diamond search algorithm for fast block-matching motion estimation*, IEEE Transactions on Image Processing 9 (February (2))(2000) 287–290.

[6] Abhishek Girotra *Motion Estimation - Sitemaker* 10 (august)2003