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Comparison And Implementation Of Block Matching Algorithms

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Abstract

Video data are rich sources of information and in order to make these data, the information content of the data has to be analyzed. A frame of video sequence at a boundary point of a shot differs in background and content from its successive frame that belongs to the next shot. Block Matching Algorithm is used to detect shot in video sequences. Vast number of Matching Algorithm have been proposed and developed to detect shot. In this paper, three Block Matching Algorithms, namely Four Step Search (4SS), Diamond Search (DS) and Adaptive Rood Pattern Search (ARPS) Algorithms are used. Implementation of these algorithms have been performed on videos and are studied and compared and obtained that ARPS is best Block Matching Algorithm for extraction of motion activity.

Keywords: BMA, ARPS, DS, 4SS, motion estimation, etc.

I. INTRODUCTION

Several advantages have been made in digital technology recently in order to make videos more valuable and useful for users. Therefore scalable, efficient and effective tools for indexing and retrieving video are needed. With large amount of information encoded in one video, typically the first step of any video processing tools is to segment the input video into elementary shots in which each shot is defined as a continuous frame from a single camera at given moment. The first step of any video processing method is to segment the input video into elementary shots. Video shot boundary detection is the initial and fundamental step of indexing, browsing and retrieval applications. For shot boundary detection technique, the motion of the moving objects has to be estimated first. This is called motion estimation. Motion estimation is a technique which determines the motion activity between frames in sequence. It searches for best motion vector to obtain motion activity in frame which is the displacement of the co-ordinate of the best similar block in previous frame and in current frame. Motion activity is one of the motion features which describes the intensity of motion in video sequence. A variety of algorithms have been developed but Block Matching Algorithm (BMA) is the most commonly used motion estimation technique in all the standard video. BMA is a way of locating matching blocks in a sequence of digital video frames for the purpose of motion estimation. In this paper, three BMAs are implemented and studied comparatively. In section II, BMAs such as Four Step Search (4SS), Diamond Search (DS) and Adaptive Rood Pattern Search (ARPS) Algorithms are explained. In section III, Experimental results for proposed algorithms are presented and are compared in terms of number of computations per macroblock and Peak-Signal-to Noise-Ratio. Section IV gives conclusion followed by references.

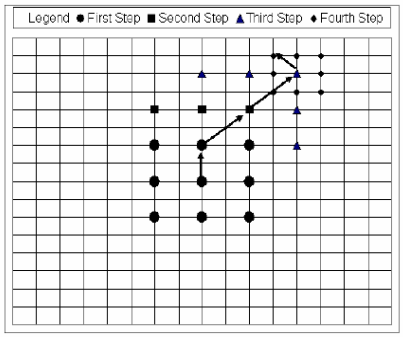
II. BLOCK MATCHING ALGORITHMS FOR MOTION ESTIMATION

1. Four Step Search (4SS) Algorithm:

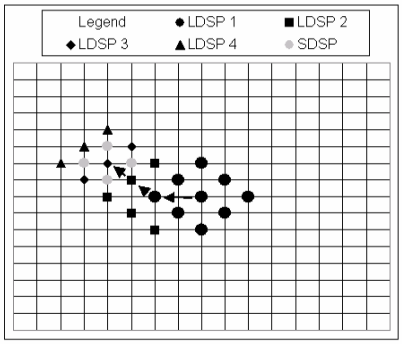
Four Step Search uses a centre biased search pattern for the sequence having maximum motion activity. It has provision to stop in the middle of the process. It is a four step method in which search point window is square. On first step, the step size is 2 and a search window of 5×5 is created which contain nine points around the centre of search window. Then search for the location that has least weight. If centre point of window has least weight then move to fourth step otherwise find that location out of eight other locations that has least weight, consider it as origin and jump to the next step. In second step, the search window is still 5x5 pixels wide. Again search for location that has least weight and if it is at centre then jump to fourth step otherwise to third step. Repeat this procedure for third step also. In fourth step, step size becomes equal to 1 and search window becomes 3×3. Then find the location that has least weight which will be the best matched block and record the motion vector. The 4SS method is shown in fig 1(a). This search algorithm has worst case of 27 checking points.

2. Diamond Search (DS) Algorithm:

Diamond Search algorithm, another BMA, is the same as 4SS, but the search pattern is changed from square to diamond. DS uses two different types of fixed patterns, they are Large Diamond Search Pattern (LDSP) and Small Diamond Search Pattern (SDSP). These two patterns are shown in fig. 1(b). Here the search pattern is neither too small nor too big and since there is no limit to the number of steps, this algorithm can find global minimum accurately.



(a)



(b)

Fig.1. (a)The Four Step Search procedure, (b) Diamond Search procedure.

3.Adaptive Rood Pattern Search (ARPS) Algorithm:

ARPS algorithm makes use of the fact that the general motion in a frame is usually coherent, i.e. if the macro blocks around the current macro block moved in a particular direction then there is a high probability that the current macro block will also have a similar motion vector. This algorithm uses the motion vector of the macroblock to its immediate left to predict its own motion vector. An example is shown in fig 3. The predicted motion vector points to (3, -2). In addition to checking the location pointed by the predicted motion vector, it also checks at a rood pattern distributed points, as shown in fig 2, where they are at a step size of S = Max (|X|, |Y|). X and Y are the x-coordinate and y-coordinate of the predicted motion vector. This rood pattern search is always the first step. It directly puts the search in an area where there is a high probability of finding a good matching block. The point that has the least weight becomes the origin for subsequent search steps, and the search pattern is changed to SDSP. The procedure keeps on doing SDSP until least weighted point is found to be at the center of the SDSP.

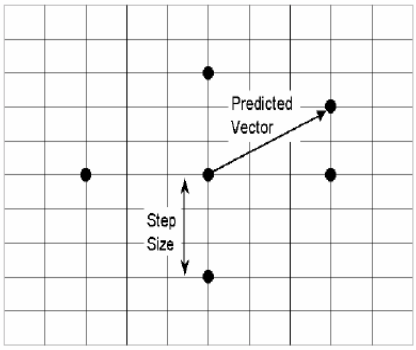
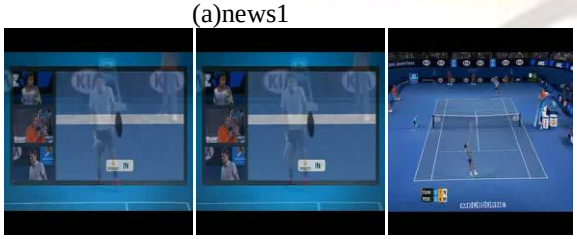


Fig.2. Adaptive Root Pattern Search Method

III. EXPERIMENTAL RESULTS

The 4SS, DS and ARPS algorithms are simulated for news videos and tennis video sequences. Videos are avi files of dimension 320×240 at the rate of 20 frames per second. Mean Square Error is used and search parameter is equal to 7 and each frame is divided into 16×16 macroblocks. Some caltrain frames of news1, news2 and tennis video are shown in fig 3.

(a)news1 (b)news2



(c)tennis

Fig. 3. Some caltrain frames of video sequences.

Fig 4, 5 and 6 gives search points per macroblock and PSNR performance of three proposed algorithms for news1, news2 and tennis video sequence.

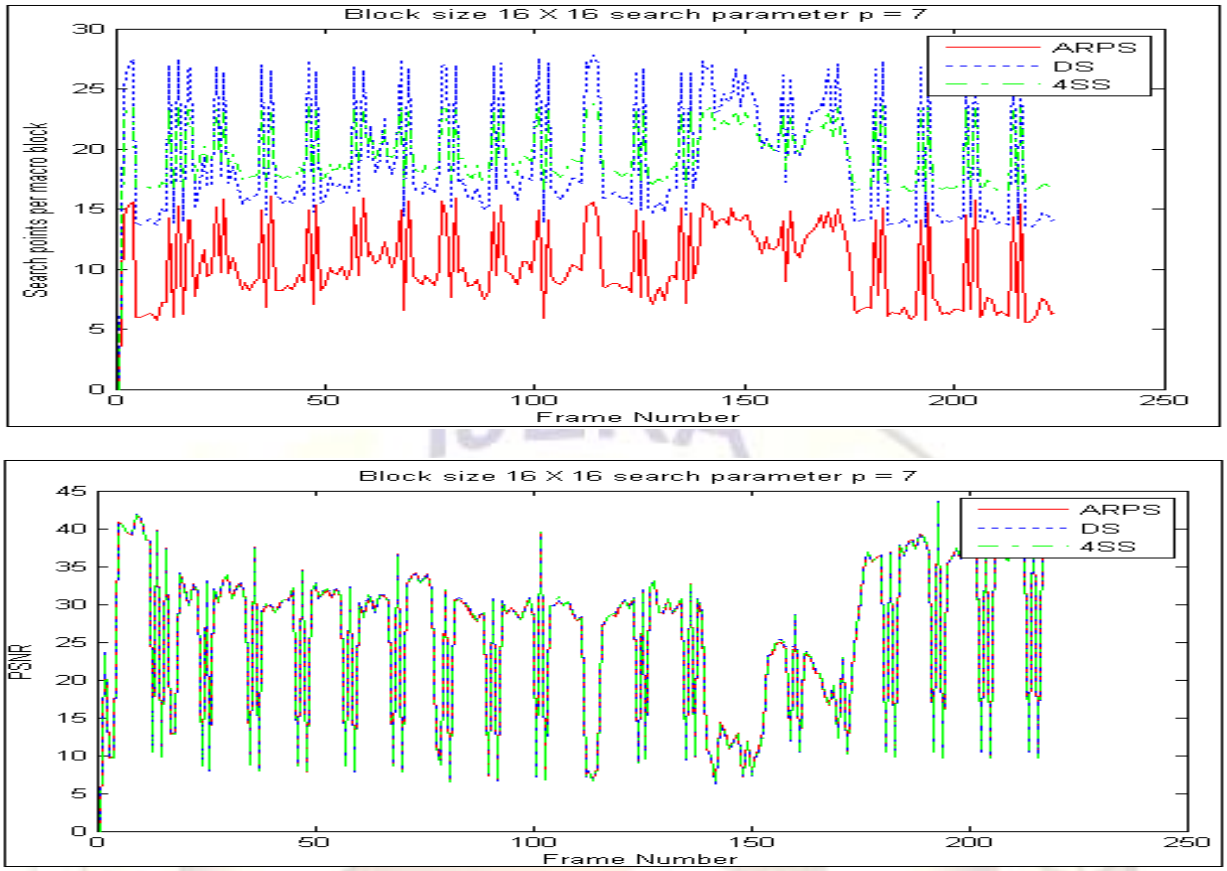


Fig 4. The comparison of performance of proposed algorithms for 225 frames of news1 sequence.

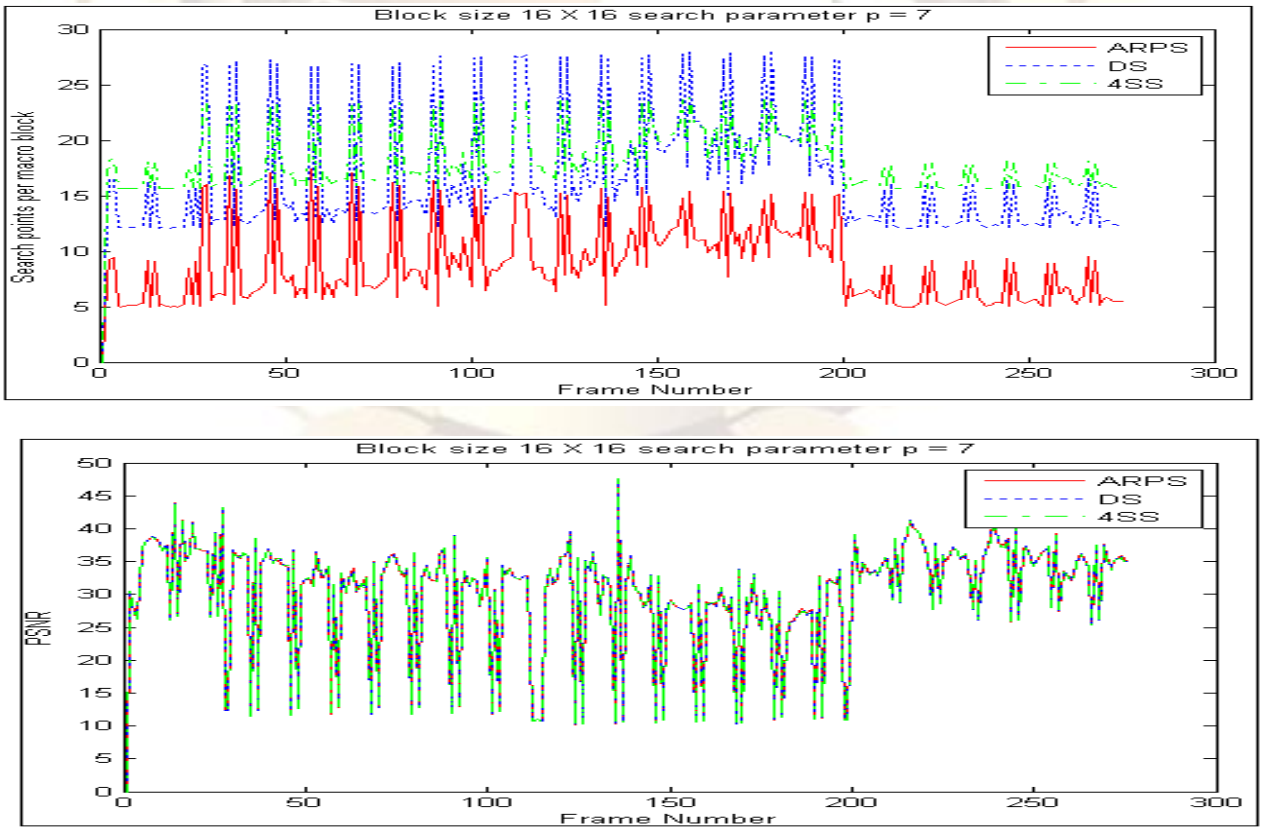


Fig 5.The comparison of performance of proposed algorithms for 227 frames of news2 video.

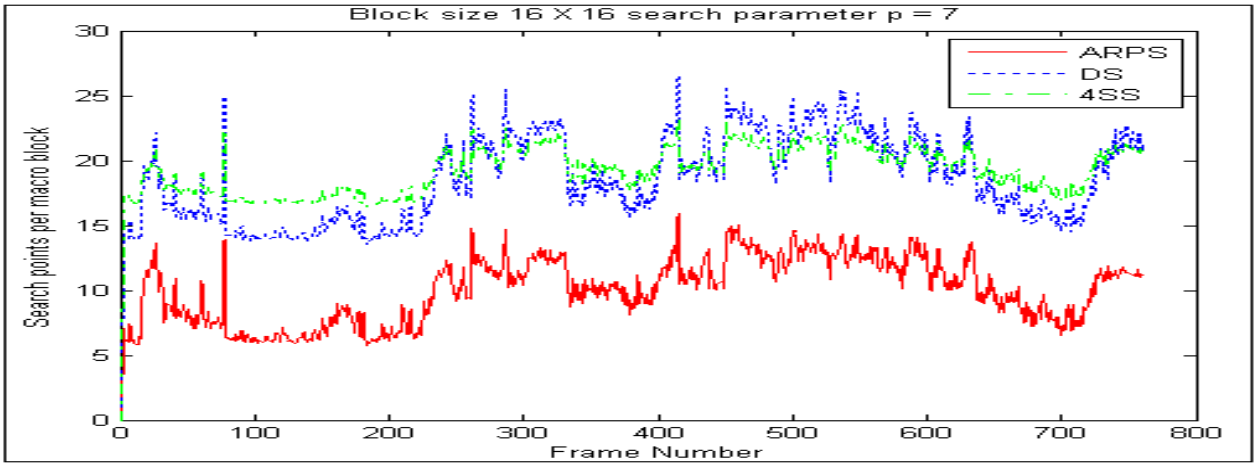


Fig 6.The comparison of performance of proposed algorithms for 764 frames of tennis video sequence.

Table 1 below shows average search point per estimation of proposed algorithms for news1, news2 and tennis video sequence. From these examples, it has been observed that ARPS takes less search points for computation than DS and 4SS so it is faster than DS and 4SS. For news1 sequence, ARPS is 1.84 times faster than DS and 1.92 times faster than 4SS. Also DS is 1.02 times faster than 4SS. Also for news2 sequence, ARPS is 1.8 times faster than DS and 2.08 times faster than 4SS. Also DS is 1.1 times faster than 4SS.For tennis, ARPS is 1.8 times faster than DS while 1.9 times faster than 4SS.

Table 1. Average search points for proposed algorithms for video sequences-

Search Algorithm Used	News1	News2	Tennis
ARPS	10.2	8.568	10.04
DS	18.86	16.24	18.61
4SS	19.31	17.9	19.25

Table 2. shows performance comparison of proposed algorithms for video sequences based on PSNR values. We can see that for tennis and news2, ARPS has high PSNR than DS and 4SS while for news1, DS and 4SS has high PSNR.

Search Algorithm Used	News1	News2	Tennis
ARPS	26.31	30.36	27.47
DS	26.33	30.36	27.41
4SS	26.33	30.32	27.4

For these observation, it can see that ARPS gives averagely high PSNR than DS and 4SS and also take less search points than other.

IV. CONCLUSION

The algorithms have been tested and studied in terms of performance for various video sequences. The comparison of algorithms has been carried out in terms of their peak signal to noise ratio performance. Search parameter p=7 used in a macroblock of size 16×16. Peak-Signal-to-Noise-Ratio (PSNR) characterizes the motion compensated image that is created by using motion vectors and macroblocks from the reference frame. Experimental results show that ARPS gives highest PSNR in comparison to DS and 4SS with less number of computations than DS and 4SS. Also ARPS takes less number of computations as compared to other algorithms and hence it is the best Block Matching

Algorithm. Hence ARPS gives overall better performance therefore, it is a very efficient and robust BMA.

REFERENCES

[1] John S. Boreczky, Lawrence A. Rowe, "Comparison of video shot boundary detection Techniques", Journal of Electronic Imaging 5(2), 122–128, April 1996.

[2] Lai-Man Po, and Wing-Chung Ma, "A Novel Four-Step Search Algorithm for Fast Block Motion Estimation", IEEE Trans. Circuits And Systems For Video Technology, vol 6, no. 3, pp. 313-317, June 1996.

[3] Shan Zhu, and Kai-Kuang Ma, " A New Diamond Search Algorithm for Fast Block-Matching Motion Estimation", IEEE Trans. Image Processing, vol 9, no. 2, pp. 287-290, February 2000.

[4] Yao Nie, and Kai-Kuang Ma, "Adaptive Rood Pattern Search for Fast Block-Matching Motion Estimation", IEEE Trans. Image Processing, vol 11, no. 12, pp. 1442-1448, December 2002.

[5] Aroh Barjatya, "Block Matching Algorithms for Motion Estimation", 2004.

[6] Abdelati Malek Amel, Ben Abdelali Abdessalem and Mtibaa Abdellatif, "Video shot boundary detection using motion activity descriptor", Journal Of Telecommunications, Volume 2, Issue 1, April 2010.

[7] Mr. Sandip T. Dhagdi, Dr. P.R. Deshmukh, "Keyframe Based Video Summarization Using Automatic Threshold & Edge Matching Rate", International Journal of Scientific and Research Publications, Volume 2, Issue 7, July 2012.