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   RESEARCH METHODOLOGY

   RESULTS & DISCUSSION

   FINDINGS

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USING NCDH SEARCH ALGORITHMS BLOCK MOTION ESTIMATION

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ABSTRACT

One of the key elements of many video compression schemes is motion estimation. A video sequence consists of a series of frames. To achieve compression, the temporal redundancy between adjacent frames can be exploited. That is, a frame is selected as a reference, and subsequent frames are predicted *from the reference using a technique known as motion estimation. In this paper, we propose two cross-diamond-hexagonal search (CDHS) algorithms, which differ from each other by their sizes of hexagonal search patterns. These algorithms employ two cross-shaped search patterns consecutively in the very beginning steps and switch using diamond-shaped patterns. To further reduce the checking points, two pairs of hexagonal search patterns are proposed in conjunction with candidates found located at diamond corners.*

KEYWORDS

BMA-Block Matching Algorithm, CDHS -Cross Diamond Hexagonal Search, CDS-Cross Diamond Search, LCSP-Large Cross Shaped Pattern, LHSP-Large Hexagonal Shaped Pattern, SCSP-Small Cross Shaped Pattern, SHSP-Small Hexagonal Shaped Pattern .

INTRODUCTION

BLOCK-MATCHING motion estimation [1] is inextricably part of today's video coding techniques and standards, such as ISO/IEC MPEG-1, 2, 4, ITU-T H.261, H.263, and the emerging H.264 Video frames are first divided into macroblocks. The displacement of these macroblocks from reference frame are reckoned and coded together with the residual frames using the generic hybrid predictive/transform coding framework.

In the last 20 years, many fast algorithms were proposed to pursue low computational complexity consumed by the full search algorithm. To reduce the exhaustive checking of candidate motion vectors, fast block-matching algorithms [2] with different block-matching strategies and their corresponding search patterns with various sizes and shapes have enormous impact on both search speed and accuracy.

The typical example is the three-step search, which employs rectangular search patterns with different sizes. Others like 2D-logarithmic search and orthogonal search algorithms performed searching in either orthogonal or linear direction. These fast algorithms result in speed improvement, however, with quality varied amongst the nature of video sequences, especially for that possessing high motion content. Afterwards, the exploitation of center-biased property by new three-step search four-step search , and block based gradient descent search algorithms increased the searching speed significantly by taking the nature of most real-world sequences into account. Meanwhile, they still maintained the prediction quality comparable with the FS's. Until the unprecedented suggestion of unrestricted search steps and nonrectangular search patterns, such as the diamond search and hexagon-based search algorithms, they required much fewer checking points, in contrast to algorithms with limited steps.

Although these fast BMAs may result in sub-optimal solution because of traps by local minima, they were usually employed in practical implementations due to their simplicity and regularity of data access.Besides the shape that candidate blocks taken for matching, the size of search patterns employed in these fast algorithms gave us an insight to the search strategies. . Moreover, they give consistently better motion estimates and directions due to larger size. Another relief of reducing checking points is to have successive search patterns overlapped as much as possible. For example, 4SS and DS requires three or five extra checking points while HEXBS requires consistently three extra points in advancing step.

Recently, cross-diamond search algorithm [5] exploits a more dominant cross-center-biased property in most real-world sequences. A more advanced idea using similar starting pattern, but with dynamic size and adaptive feature, can be found. Experimental result in compares most fast BMAs without prediction feature. It shows that CDS generally requires about two to five fewer points than DS. The speedup gain using CDS over DS is reported up to 40% with similar or even better quality than DS's. In this paper, we proposed two novel-cross-diamond-hexagonal search algorithms by employing a smaller cross-shaped pattern before the first step of CDS and replacing the diamond-shaped pattern with hexagonal search patterns in subsequent steps.

PRODUCT DESCRIPTION

In this paper, we proposed two novel-cross-diamond-hexagonal search algorithms [3] by employing a smaller cross-shaped pattern before the first step of CDS and replacing the diamond-shaped pattern with hexagonal search patterns in subsequent steps.

SEARCH PATTERNS

Two types of search patterns are used in CDHS

- Cross-Center-Biased Motion Vector Distribution
- Hexagonal Search Patterns.

EXISTING SYSTEM

In the last 20 years, many fast algorithms were proposed to pursue low computational complexity consumed by the full search algorithm. To reduce the exhaustive checking of candidate motion vectors, fast block-matching algorithms [2] with different block-matching strategies and their corresponding search patterns with various sizes and shapes have enormous impact on both search speed and accuracy.

FIGURE 1: SHOWS THE SEARCH AREA IN BLOCK MATCHING METHODS

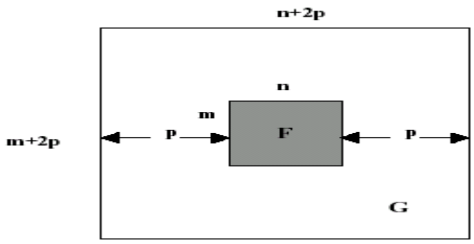


Figure 1. The search area in block matching methods

These fast algorithms result in speed improvement, holver, with quality varied amongst the nature of video sequences, especially for that possessing high motion content. Afterwards, the exploitation of center-biased property by new three-step search four-step search, and block-based gradient descent search algorithms increased the searching speed significantly by taking the nature of most real-world sequences into account. Meanwhile, they still maintained the prediction quality comparable with the FS's. Until the unprecedented suggestion of unrestricted search steps and nonrectangular search patterns, such as the diamond search and hexagon-based search algorithms, they required much felr checking points, in contrast to algorithms with limited steps. Although these fast, BMAs may result in sub-optimal solution because of traps by local minima, they Ire usually employed in practical implementations due to their simplicity and regularity of data access.

PROPOSED SYSTEM

The maximum theoretical speedup of the proposed CDHSs is about 20.5–45.0 times with window size of 7, as only five and 11 points are checked, After utilizing cross-center-biased characteristics, CDHSs can further reduce the computations by checking three more points consistently in advancing steps. Table 1 shows the performance comparisopns of CDHSs on sequence "SALES" (CIF).

TABLE - 1

PERFORMANCE COMPARISONS OF CDHSS ON SEQUENCE "SALES" (CIF)

BMA	N_S	Speedup	MAD	Distance[a]	Prob.[b]
FS	204.283	1.000	2.864	0.000	100.000
3SS	23.212	8.801	2.916	0.246	94.710
N3SS	16.935	12.063	2.872	0.076	98.020
4SS	16.206	12.605	2.908	0.207	95.440
DS	13.019	15.692	2.907	0.215	95.120
CDS	9.495	21.514	2.874	0.083	97.830
CDHS-T	**6.963**	**29.337**	**2.876**	**0.086**	**97.550**
CDHS-F	**6.927**	**29.492**	**2.876**	**0.086**	**97.720**

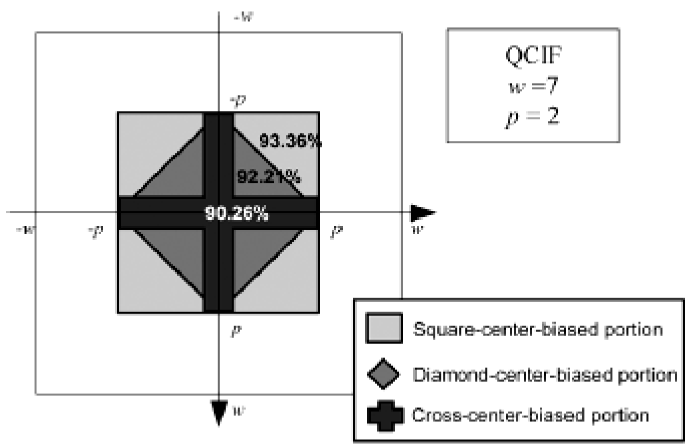
Therefore, the average gain using CDHS-F over DS with window size of 7 is 3.56 search points per block. All the theoretical gains of CDHSs over 4SS, DS and CDS. It shows that the gain over 4SS is larger than that of DS, and is larger than CDS's. It also shows that CDHS-F generally checks felr points than CDHS-T, i.e., number of candidate points checked: CDHS-F<CDHS-T <DS .

SYSTEM DESIGN DESCRIPTION

CROSS-CENTER-BIASED MOTION VECTOR DISTRIBUTION

In addition, the average motion vector probability distributions taken from 31 sequences, in CIF/SIF/CCIR601 formats are analyzed. These sequences consist of different motion contents, from gentle to vigorous motion activities. The MVPs are resulted from simulations using FS with mean absolute difference as the block distortion measure inside a search area, typically is set to 7 for QCIF/CIF/SIF and to 15 for CCIR601 sequences. the probabilities in which motion vectors are found within the cross ( ), diamond ( )and square ( ) region, over 93% of motion vectors are found within the central area when using QCIF sequences. This is shown in figure 2.

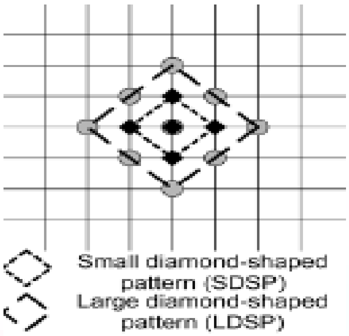
FIGURE 2



This is a square-center-biased distribution indicating most of real-world sequences move gently, smoothly and slowly, and can be regarded as quasistationary. Within this square region, about 90% and 92% motion vectors are found located in the cross-center-biased and diamond-center-biased portions. Amongst these three shaped-distributions, CCB distribution is the most dominant.

Moreover, such cross-biased behavior maintains over 93% at boundaries of search area. Similar center-biased properties distributed as a cross, diamond and square shape are found in CIF/SIF and CCIR601 formats. This shows the CCB occupies the most proportion at different displacement p,p € w, especially when 1≤p≤2. Thus, a small cross-shaped pattern is employed in the very beginning of the proposed algorithms, prior to the large cross-shaped pattern used in CDS shown in figure 3.

FIGURE 3

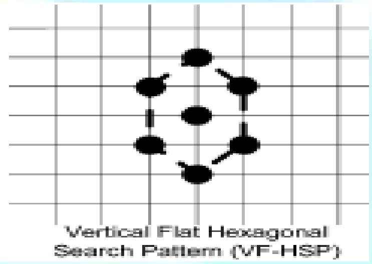


These two cross-shaped patterns can work more efficiently on finding small motion vectors than diamond-shaped ones within the central 5 ×5 area in the first two steps. Afterwards, the proposed search algorithms will use the large Diamond-shaped pattern for better performance on large motion vectors and possibly stop the search using a small diamond-shaped pattern if the previous minimum BDM found in the diamond center.

HEXAGONAL SEARCH PATTERNS

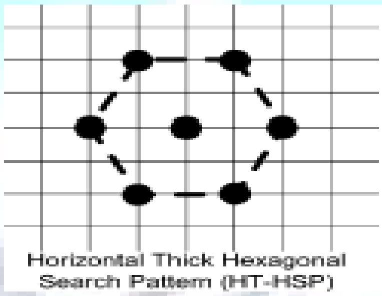
Translation, zooming, pan and tilt motions are usually found in video. This block movement will easily fall on the diamond corners if DS is employed for coding. There is still a room to reduce two fewer points between successive steps of DS by switching the LDSP into HSPs. This is shown in figure 4.

FIGURE 4



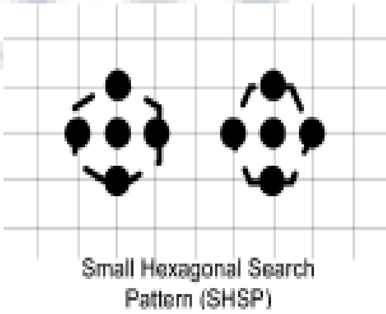
However, it is not always true as motion direction may be “diversified” into other directions as the frame dimension increases, i.e., falling onto the diamond faces. This can be indicated by the decrease from about 43% to 40% when changing the sequence “tennis” from CIF to CCIR601 format. This is shown in figure 5.

FIGURE 5



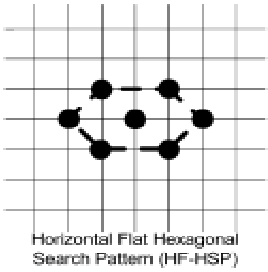
The diamond-corner hits will be dropped if the smaller SCSP is used to allow earlier halfway stop. The use of SCSP is applied in prior to the CDS algorithm (fig 6). The probabilities of the search path hitting a diamond corner are generally dropped due to the earlier halfway-stop condition. With exploiting the cross-center-biased property, the drop may be tremendous.

FIGURE 6



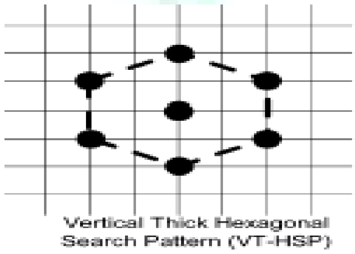
Nevertheless, there is still a big room to consider a switch into another search pattern, such as hexagonal patterns, in order to reduce the extra checking points in advancing from a diamond corner, especially for some rich motion clips with motions oriented orthogonally. It is shown in figure 7.

FIGURE 7



Two pairs of LHSPs. Each pair consists of two orientations: vertical and horizontal. These two pairs are different in their sizes. Checking points spanned in the SHSP are physically the same as SCSP and SDSP and proposed for the sake of completeness after pattern switched. Fig. 8.

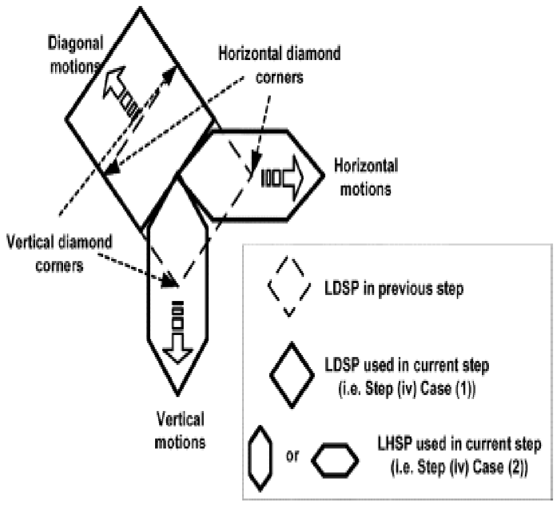
FIGURE 8



Based on the search strategy of DS. The thick ones advance the search with bigger steps and result in faster search speed than the flat ones, but make sacrifice for quality. Conversely, the flat ones give better quality, as they require more steps and thus more points.

In short, it is a prior problem that I cannot know the nature of a sequence in advance. Therefore, a diamond-shaped pattern, i.e., LDSP, plays an important role in our proposed CDHSs. Three possible directions that the minimum BDM found located in the previous LDSP. Either a pair of LHSPs will be consistently used throughout the search. Figure 9 shows the Search patterns switched for different directions

FIGURE 9: SEARCH PATTERNS SWITCHED FOR DIFFERENT DIRECTIONS



DEVELOPMENT SPECIFICATION

CROSS-DIAMOND-HEXAGONAL SEARCH

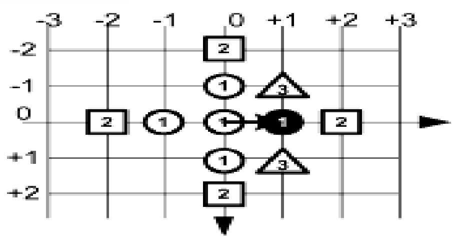
FLOW OF THE CDHSs

The proposed CDHS algorithms [3], [4] differ from DS, HEXBS, and CDS by performing a highly cross-center-biased search with SCSP in the first step. In addition, the search may involve up to two different patterns: diamond-shaped LDSP and hexagonal pair LHSP. The common strategy amongst them is employing a halfway-stop technique. The following summarizes the CDHS algorithms.

Step (i) Starting: A minimum BDM point is found from the five checking points of SCSP at the center of search area. If the minimum BDM occurs at SCSP center, the search stops.

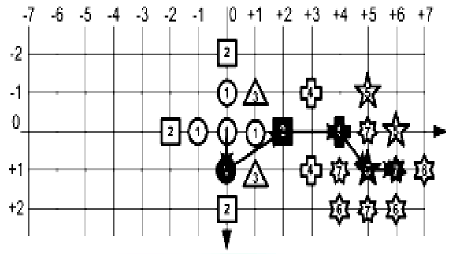
Step (ii) Large Cross Searching: The four outermost points of the central LCSP are evaluated. (fig 10).

FIGURE 10



Step (iii) Half-diamond Searching: Two additional points of the central LDSP closest to the current minimum BDM of the central LCSP are checked, i.e., two of the four candidate points located at. If the minimum BDM found in previous steps is at any endpoint of SCSP (fig 11).

FIGURE 11



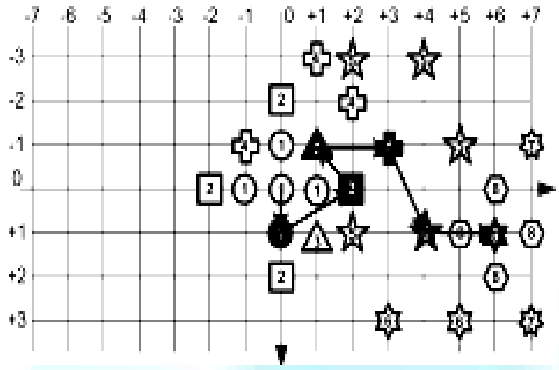
STEP (IV) SEARCHING

Case (1): If LDSP is used in previous step and the minimum BDM is found located at any point on diamond edge, a new LDSP is formed by repositioning the previous minimum BDM point as the center of LDSP.

Case (2): If LDSP is used in previous step and the minimum BDM is found located at either of the horizontal (vertical) diamond corners, a new horizontal (vertical) LHSP is formed by repositioning the previous minimum BDM as the center of LHSP.

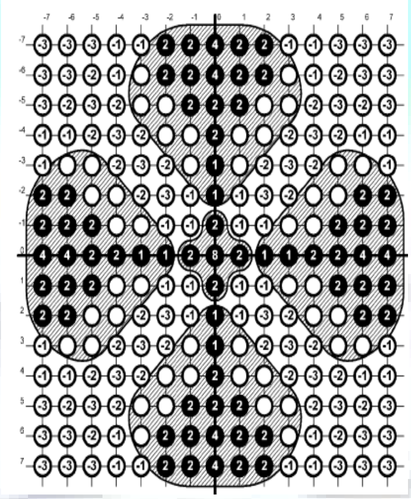
Case (3): Otherwise, a new LHSP of the same shape is formed by repositioning the previous minimum BDM as the center of LHSP.For any case above (LDSP LDSP, LDSP LHSP, orLHSP LHSP), three new checking points1 are evaluated. (fig. 12).

FIGURE 12



Step (v) Ending: With the minimum BDM point in the previous step as the center, a new SDSP is formed if LDSP is used in previous step; otherwise, a SHSP is employed instead. Identify the new minimum BDM point, which is the final motion vector, from the four new candidate points2 in SDSP or SHSP. Figure 13. Shows the Gain in search points using CDHS-F over DS.

FIGURE 13: GAIN IN SEARCH POINTS USING CDHS-F OVER DS.



IMPLEMENTATION

In this paper, we proposed two novel-cross-diamond-hexagonal search algorithms by employing a smaller cross-shaped pattern before the first step of CDS and replacing the diamond-shaped pattern with hexagonal search patterns in subsequent steps. We had used four frames for searching which was taken from already stored frames. And will try to implement this paper (project) with mpeg compression. CDHS algorithms are simulated using the luminance of the testing sequences .Block size of 16 and sum of absolute difference as the BDM are used. It shows that the speedup gain using CDHS-F over DS is up to about 144% and gain over CDS is about 73%. In addition, CDHS-F can also provide even better prediction quality, indicated by negative values. e.g., 2.7% lesser MAD error than DS's. In particular, they improve searching speed by about 144% faster than diamond search algorithm and about 73% faster than the cross-diamond search.

CONCLUSION

We proposed two fast cross-diamond-hexagonal search algorithms, namely CDHS-F and CDHS-T. They differ from each other in their hexagonal search pattern sizes. Both are suggested to firstly employ a small cross-shaped pattern to explore the cross-center-biased property of most real-world sequences. They then typically perform block matching as in DS, but switch using hexagonal search pattern in advancing steps. Experimental results show that our proposed CDHSs typically outperform other fast BMAs. In this paper we had used four frames for searching which was taken from already stored frames. In future, we will try to implement this paper (project) with mpeg compression. It shows that the speedup gain using CDHS-F over DS is up to about 144% and gain over CDS is about

73%. In addition, CDHS-F can also provide even better prediction quality, indicated by negative values. e.g., 2.7% lesser MAD error than DS's. In particular, they improve searching speed by about 144% faster than diamond search algorithm and about 73% faster than the cross-diamond search. It shows that the speedup gain using CDHS-F over DS is up to about 144% and gain over CDS is about 73%. It is shown in the Table 2. Figure 14 and 15 shows the results of the block-matching algorithm for full search and cross diamond hexagonal search.

TABLE 2: EXPERIMENTAL RESULTS SHOW THAT PROPOSED CDHSs

Motion Estimation Algorithm	Execution Time ms	Number of Search points	Low Complexity implementation execution time ms
Full Search	234.059	9801	92.937
Three Step Search	85.104	2009	36.680
New Three Step Search	45.582	1540	26.882
Diamond Search	73.501	1249	53.006
Hexagonal Search	43.970	1249	35.309
Cross Diamond Hexagonal Search	33.564	660	28.510

FIGURE 14: THE RESULTS OF THE BLOCK-MATCHING ALGORITHM FOR FULL SEARCH

FIGURE 15 SHOWS THE RESULTS OF THE CROSS DIAMOND HEXAGONAL SEARCH

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