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# ANALYSIS OF BLOCK MOTION ESTIMATION TECHNIQUES IN VIDEO COMPRESSION

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**Abstract:** Block matching motion estimation is a key Component in video compression because of its high computational complexity. The process of motion estimation has become a bottleneck problem in many video applications. In recent years, several video compression standards had been proposed for different applications such as CCITT H.261, MPEG-1, MPEG-2, MPEG-4, H.264, VC-1. One common feature of these standards is that they use DCT transform coding to reduce spatial redundancy and block motion estimation/compensation to reduce the temporal redundancy. In addition, the encoders complexity of these video standards are dominated by the motion estimation, if Full Search(FS) is used as the block matching algorithm(BMA). FS matches all possible displaced candidate blocks within the search area in the reference frame, in order to find the block with the minimum distortion. Massive computation is, therefore, required in the implementation of FS. Many fast BMAs had been developed to alleviate the heavy computation of FS. Typical applications include HDTV, multimedia communications, video conferencing, etc. Motion estimation is a useful in estimating the motion of any object. Motion estimation has been conventionally used in the application of video encoding but nowadays researchers from various fields other than video encoding are turning towards motion estimation to solve various real life problems in their respective fields.

**Keywords:** Block Motion, Video Compression

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## INTRODUCTION

Motion compensated transform coding forms the basis of the existing video compression Standards H.26 1/H.262 and MPEG- 1 /MPEG-2, where the compression algorithm tries to exploit the temporal and spatial redundancies by using some form of motion compensation followed by a transform coding, respectively. The key step in removing temporal redundancy is the motion estimation where a motion Vector is predicted between the current frame and a reference frame. Following the motion estimation, a Motion compensation stage is applied to obtain the residual image, i.e. the pixel differences between the current frame and a reference frame. Later this residual is compressed using transform coding or a combination of transform and entropy coding. The above Video compression standards employs block motion estimation techniques. The main advantages of FSBME (fixed size block motion estimation) are simplicity of the algorithm and the fact that no segmentation information needs to be transmitted [1]-[2]-[3].

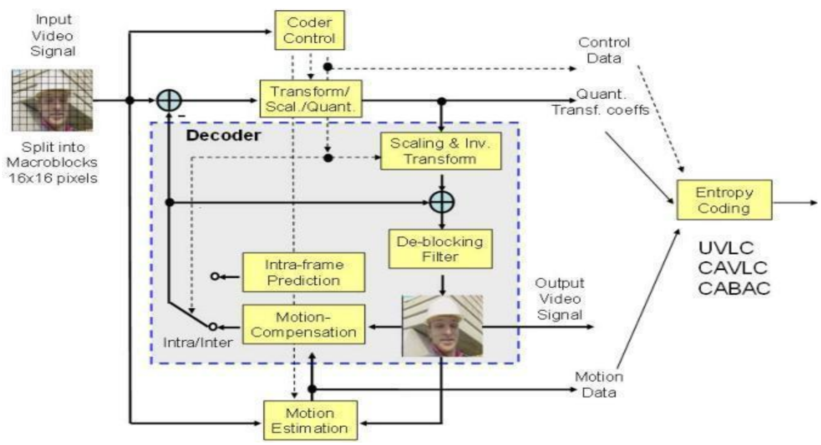



Fig. 1 Video compression process

In block motion compensated video coding; first image frames are divided into square blocks (FIXED SIZE). The next step is to apply a three-step procedure, consisting of Motion Detection, Motion Estimation and Motion Compensation. Motion detection is used for classifying blocks as moving or non-moving based on a predefined distance or similarity measure. This similarity measure is usually done by MSE (minimum mean square error) criteria or minimum SAD (sum of absolute different) criteria. The output of the motion-estimation algorithm comprises the motion vector for each block, and the pixel value differences between the blocks in the current frame and the “matched” blocks in the reference frame. We call this difference signal the motion compensation error, or simply block error. Many techniques have been proposed for motion estimation for video compression so far. All the methods are proposed keeping any one or more of the three directions aimed that 1.reducing computational complexity 2.representing true motion (proving good quality) 3.reducing bit rate(high compression ratio).

The key to high performance of video compression lies in an efficient reduction of the temporal redundancy. For this purpose, the block-based motion estimation (BBME) technique has been successfully applied in the video compression standards from H.261 to H.264. The most straightforward BBME method must be full search algorithm (FSA) that searches every candidate position within the search range.

The various block matching algorithms are Three Step Search (TSS), Diamond Search (DS) and Two Dimensional Logarithmic Search. In this paper, review of the various block matching based motion estimation algorithms are presented.

**SECTION-II**

***A. Block Matching Algorithms:***

Block matching motion estimation (BMME) is the most widely used motion estimation method for video coding. The underlying supposition behind motion estimation is that the patterns corresponding to objects and background in a frame of video sequence move within the frame to frame The idea behind block matching is to divide the current frame into a matrix of „macro blocks‟ that are then compared with corresponding block and its adjacent neighbours in the previous frame to create a vector that stipulates the movement of a macro block from one location to another in the previous frame. This movement calculated for all the macro blocks comprising a frame, constitutes the motion estimated in the current frame. The search area for a good macro block match is constrained up to p pixels on all fours sides of the corresponding macro block in previous frame. This „p‟ is called as the search parameter. Larger motions require a larger p and the larger the search parameter the more. Computationally expensive the process of motion estimation process. Usually the macro block is taken as a square of side 16 pixels, and the search parameter p is 7 pixels.

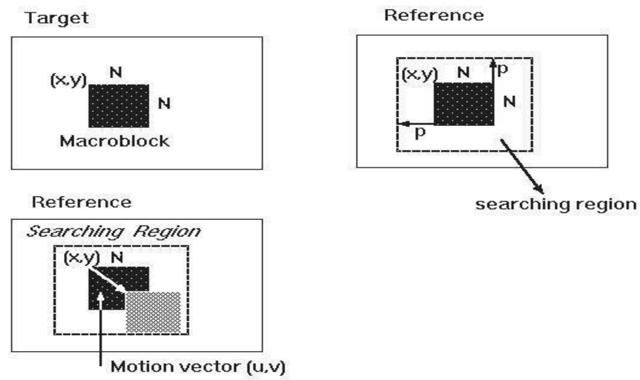



**Fig. 2: Block based Motion Estimation process**

The idea is represented in Fig 2. The matching of one macro block with another is based on the output of a cost function. The macro block that results in the least cost is the one that matches the closest to current block. The most intuitive approach for block matching is to use the full search algorithm (FSA).

**SECTION-III**

***2.1. Full Search Method:***

This algorithm, also known as Full Search, is the most computationally expensive block matching algorithm of all. This algorithm calculates the cost function at each possible location in the search window. As a result of which it finds the best possible match and gives the highest PSNR amongst any block matching algorithm. Fast block matching algorithms try to achieve the same PSNR doing as little computation as possible. The obvious disadvantage to ES is that the larger the search window gets the more computations it requires 169 iteration if p=6 and it requires 289 iteration if p=8.

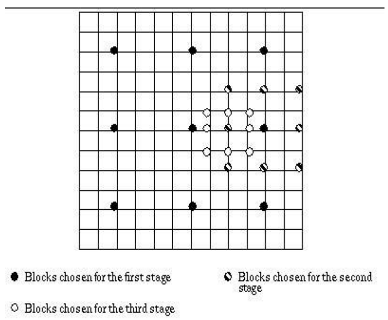
***2.2. Three Step Search-Full search:***

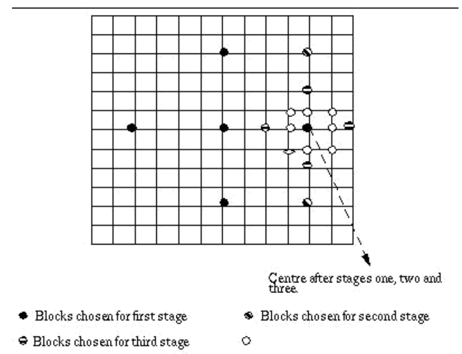
It searches for the best motion vectors in a coarse to fine search pattern. The algorithm may be described as:

Step 1: An initial step size is picked. Eight blocks at a distance of step size from the centre (around the centre block) are picked for comparison.

Step 2: The step size is halved. The centre is moved to the point with the minimum distortion.

Steps 1 and 2 are repeated till the step size becomes smaller than 1. A particular path for the convergence of this algorithm is shown below:




***2.3. Two Dimensional Logarithmic Search:***

Although this algorithm requires more steps than the Three Step Search, it can be more accurate, especially when the search window is large. The algorithm may be described as:

Step 1: Pick an initial step size. Look at the block at the Centro the search are and the four blocks at a distance of s from this on the X and Y axes. (The five positions form a + sign)

Step 2: If the position of best match is at the centre, halve the step size. If however, one of the other four points is the best match, then it becomes the centre and step 1 is repeated.

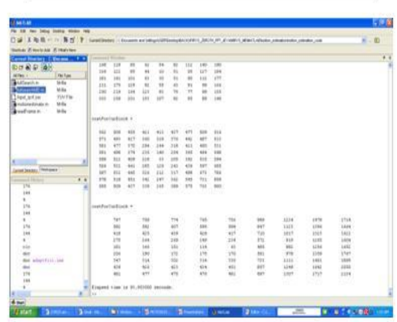
Step 3: When the step size becomes 1, all the nine blocks around the centre are chosen for the search and the best among them is picked as the required block.

A particular path for the convergence of the algorithm is shown in the following figure:

**SECTION-IV**

**RESULT OBTAINED: Full Search Method**

**ESTIMATING ME TIME FOR 33 FRAMES VIDEO WITH DISPLAYING THE COST**



**SECTION-V**

**CONCLUSION:**

A review of the various block matching based motion estimation algorithms has been presented. These algorithms are classified into three categories, namely, fast algorithms, true motion or good quality oriented methods and low computation complexity VSBME techniques algorithms. Algorithms are reviewed, in terms of both coding efficiency and computational complexity. Additionally, in order to design a low complexity ME algorithm, the researchers should jointly use the powerful techniques to reduce the computational cost in different aspects. When used well together, the new design will significantly reduce the computational cost, as compared with the traditional fast ME algorithms.

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