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A Study on Algorithms for Block Motion Estimation in Video Coding

Sharon Elsa Mathew[1], Mrs.S.Kokila[2]

[1]*PG Scholar, Department of ECE, Vivekanandha College of Engineering for Women, Namakkal, India.*
[2]*Assistant Professor, Department of ECE, Vivekanandha College of Engineering for Women, Namakkal, India.*

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ABSTRACT

Block matching algorithm (BMA) for motion estimation is extremely normally utilized in current video coding standard like H.26x and MPEG-x as a result of its simplicity and performance and also it is a very important content in video compression the motion estimation is becoming a problem in many video applications as it to estimate the motion of the object. There are homography between 2 frames within the video sequences captured by pan-tilt (PT) cameras in their unnatural movements and therefore the geometric relationship is used to reduce the spatial redundancy in the video. In this paper, I present a homography based motion estimation algorithm and a comparative study of different algorithms. Also I introduce a unique homography-based motion for block motion estimation. This study is to provide an idea about the important tradeoff between computational complexity, result quality and various applications. This algorithm can be done on Matlab.

Keywords: Block Motion Algorithm, PT camera, Homography.

1. INTRODUCTION

In current video coding standards such as H.26x and MPEGx, block matching algorithms (BMAs) has been widely used for motion estimation. The most straightforward algorithm is the full search (FS). FS can obtain the global optimal motion vector (MV); however, it is time-consuming. To speed up the process of block motion estimation (BME), many fast BMAs have been developed to speed up the process of block motion estimation. One way is to improve the search patterns based on the study of motion-vector distribution characteristics. The second one is to obtain better starting points using spatial or temporal correlation between blocks. The algorithms using a certain approach are usually efficient for the series with certain motion characteristics. In the last decade, the algorithms which blend the approaches mentioned above together has been developed rapidly with the advantages of the above approaches combined these algorithms.

Many algorithms are introduced to compute the homography between two frames by using information on images. Mainly by exploiting the homography between two frames, many algorithms are proposed for block motion estimation in coding the sequences captured by PTZ cameras. Pan-tilt (PT) cameras are commonly used in such fields as surveillance, distance learning, patient care, and reconnaissance and space exploration. Due to the constrained movement, there lies a geometric relationship between two frames in the video sequences captured by PT cameras. The geometric relationship has been studied and utilized for motion detection or tracking but few of the BMAs utilize the inherent relationship in coding the increasing video sequences captured by PT cameras.

In this paper, I present a review of the various block matching based motion estimation algorithms. Many techniques have been proposed for the motion estimation for video coding so far. All the method is proposed aiming that 1. Reduce computational complexity 2. Representing true motion (provide good quality), 3.reducing bit rate (high compression ratio).

2. RELATED WORKS

Chukka Santosh, Prayline Rajabai C and S Sivanantham (2017) introduced SAD Architecture for Variable Block Size Motion Estimation in H.264 Video Coding. In this paper, the high throughput hardware architecture is designed to calculate the Sum of Absolute Difference (SAD) based on the variable block size of the image. Even though the fixed block size motion estimation is simple with respect to the complexity of the variable block size motion estimation, variable block size estimation technique results in exquisite performance. The hardware implementation of SAD is done using Comparator and Carry skip adder. Comparator and Carry skip adder unit improves the performance of SAD calculation in terms of speed, area, and power. They also proposed a control unit for H.264 video. This proposed control unit calculates the SAD output values according to block size given as input to control unit.

Ashika K O, N ManjaNaik, Parameshachari B D, ReshmaBanu and Rajashekarappa (2017) introduced Inter Frame Coding in Advanced Video Coding Standard H.264 using Block Based Motion Compensation Technique. In this, the working of video coding techniques is briefly explained. Out of two types frame coding method a block based motion estimation and motion compensation module is implemented and also they implemented an advanced video encoding module based on inter frame video technique is implemented. To predict the future frame based on the current frame and previous frame they performed particular block based motion estimation. A respective motion vector based on the motion compensation and current frame information is obtained. Here previous frame is used to predict the future frame, motion estimation predict the motion vector. The resultant vector information is encoded to transmit high quality video information in a less bandwidth.

Yucheng Sun and Lu Yu (2017) explored a geometric motion model to derive a geometric derived motion vector (GDMV) when an object has a relative movement that is close to or away from the camera. The proposed GDMV is integrated to HM 16.0 to further improve the motion prediction in HEVC. In order to ensure the accuracy of the motion vector predictor, a refining process is adopted before integrating the model into HEVC motion vector prediction. Experimental results showed that compared to HM 16.0, the proposed GDMV can bring 0.14%~1.13% BD bitrate saving in low delay P main test. In the proposed motion model, object has only a slight rotation with large τ value.

Shyamala Kattula and MalleshamDasari (2016) proposed an efficient and fast motion estimation (ME) algorithm for High Efficiency Video Coding (HEVC). The proposed work was based on video content that gives the provision to select a best macro block mode and suitable search pattern for a given slice of the video frame. Based on a tiered scene labeling mechanism, each frame is divided into multiple slices and a suitable search pattern is estimated for each slice by investigating texture of the slice. The interspace distance between a macro block in current frame to the candidate macro block in the previous frame is calculated for all the macro blocks in a slice, to find the block movement factor (BMF) which identifies an appropriate search pattern for that slice. Also, the disparity between the neighboring blocks is measured for each slice to predict the mode to be considered for block matching in next

frame. The experimental analysis was performed with x265 video codec, which shows considerable amount (20%) of improvement in compression performance.

Mahmoud Ahmadi, Ali Wali, AhlemWalha and Adel M. Alimi (2015) introduced a New Motion Estimation Technique for Video Coding. This paper presented REGIM Video Coding (REGIMVC) as a new video coding technique. REGIM-VC proposes an efficient motion estimation algorithm based on block matching. The proposed algorithm is to improve the compression performance by applying new Motion Estimation techniques. So it reduces the search points number in Motion Estimation block of video codec. Consequently, it saves significantly the bit-rate and the computational time. This method had proved its performance when it will be tested under x265 framework.

P.Jayakrishnan and Harish.M.Kittur (2014) presents a new design for the implementation of Full- Search (FS) Variable Block Size (VBS) Motion Estimation (ME), which is a key issue of different video compression standards such as MPEG-1, MPEG-2, MPEG-4 Visual, H.261, H.263 and H.264. The FS algorithm is widely used for implementation of ME in video compression algorithms. This design is fully parametric in terms of block size, which is variable, and the Sum of Absolute Differences (SAD) is presented by re-using the outputs. These architectures were designed using Verilog Hardware Description Language (HDL) and the functionalities are verified using ModelSim Simulator.

Yogananda Patnaik, Dinesh Kumar Singh and Dipti Patra (2014) explored a new search method for block motion estimation in video compression. The purpose of the paper was to review recent research on the search techniques for block motion estimation, and to present a new search method for the same which uses its neighboring blocks for the prediction of motion vectors. This method had used the motion vectors of neighboring blocks which are more likely to be helpful in the prediction process. A search center is located, with the help of these motion vectors; a search window is placed around it. In this paper, they had also proposed sorted method algorithm by forming a combination of current block with different neighborhood blocks, and compared the result. The performance of the algorithm was then compared with the FSA, ARPS, and diamond search (DS) and TSS algorithms.

Abdou Khadre Diop, K. Tall, S. M. Farssi and I. Diop (2014) presents a performances of the estimation and motion compensation for the reconstruction of motion areas in a sequence video Motion JPEG 2000. In this paper, they proposed a technique of estimation and motion compensation for optimal recovery of lost packets in motion areas. The application implemented in Matlab can see firsthand the disappearance of the effects of blocks in the transmission of video sequence Motion JPEG 2000 in a very noisy environment. The transmission of video sequences Motion JPEG 2000 is not entirely reliable in a very noisy environment, since attending packet loss in the code stream the movie Motion JPEG 2000. For a reconstruction of the lost packets, the method of conditional replenishment has been proposed. However, with this method, the effects of blocks appear in motion areas making the quality of the video poor in these areas.

Ailing Zhang, Xiaopeng Fan, Ruiqin Xiong and Debin Zhao (2013) proposed a new method of distributed soft video broadcast with variable block size motion estimation. In this paper, they used the variable block size motion estimation to replace the fixed block size motion estimation, that will efficiently reduce the block effect and also it will improve the quality of the reconstructed frame generated using motion compensation and predicted frame. On the coding side, complexity does not add too much and the predicted frame of the encoding side and decoding side is more accurate, thereby the reconstructed frame generated by motion compensation and predicted frame is better. The DCAST with variable block size motion estimation is proved to be 0.5dB better than DCAST with fixed block size motion estimation.

Yanfei Shen, Jintao Li and Zhenmin Zhu (2013) described a based on sparse representation, which is applied in video coding to reduce the temporal redundancy. The sparse coefficients are firstly calculated in support region by orthogonal matching pursuit (OMP) algorithm using the reference blocks as dictionary elements, and then these optimal sparse coefficients are utilized to predict the current block. To get the same prediction in decoder, the number of iterations in OMP is transmitted to decoder as side information. Simulation results showed that gain up to 2.87dB in terms of the PSNR when compared with traditional translational motion estimation model.

TABLE 1: Comparison between block matching methods

SL NO	PAPER TITLE	ADVANTAGES	DRAWBACKS
1	A SAD Architecture for Variable Block Size Motion Estimation in H.264 Video Coding	Improves the performance in terms of speed with a good frequency.	Block size varies the complexity increases.
2	Inter Frame Coding in Advanced Video Coding Standard H.264 using Block Based Motion Compensation Technique	Transmits high quality video information in a less bandwidth.	Time decoding in inter frame coding is complex.
3	Geometric Derived Motion Vector for Motion Prediction In Block-Based Video Coding	Derive a geometric derived motion vector (GDMV).	Complexity in selecting the suitable neighboring MV pair.
4	On the Adaptive Motion Estimation in Video Coding Based on Video Content Analysis	Select a best macro block mode and suitable search pattern.	Introduces discontinuities at the block borders.
5	A New Motion Estimation Technique for Video Coding	Reduces the search points number in Motion Estimation block of video codec.	Computation is more expensive.
6	2-Dimensional Systolic Architecture for H.264/AVC Variable Block Size Motion Estimation	1-D and 2-D design of ME block is developed for VBS using FS algorithm.	Computational time is high to identify a best matching block.
7	A New Search Method for Block Motion Estimation in Video Compression	Sorted method algorithm is proposed.	As the number of blocks increases in the sorted search

			method, the computation time increases.
8	Performances of the estimation and motion compensation for the reconstruction of motion areas in a sequence video Motion JPEG 2000	Recover lost packets in motion areas.	Lacks very high reliability in the motion of areas video.
9	Distributed Soft Video Broadcast with Variable Block Size Motion Estimation	Reduce the block effect and improve the quality.	Rate distortion optimization performing on every possible mode will greatly increase the coding complexity.
10	Motion Estimation for Video Coding based on Sparse Representation	A motion estimation algorithm based on sparse representation is proposed.	The coefficients of sparse representation are calculated in real time, so it has more computation complexity.

3. CONCLUSION

A review of the various block matching based motion estimation algorithms has been presented. These features, advantages and disadvantages of those algorithms have been presented. It is a very important content in video compression the motion estimation is becoming a problem in many video applications such as HDTV, multimedia communications, video conferencing as it to estimate the motion of the object. In addition, I have been briefly reviewed the various matching. Algorithms are reviewed, in terms of both coding efficiency and their computational complexity.

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Block matching algorithms can be used for implementing the video stabilization process. The proposed algorithm in this paper avoids shakiness from a raw video of YUV and results in stabilizing in YUV video.Â Video stabilization plays an important role in dynamic image coding and processing to remove hand-shaking effects in a handheld camera or PC (Yang et al., 2015). The proposed application can be installed in these handheld cameras or PC to get converted stabilized video and its further processing from a raw video (Okayed et al., 2015). 2 background of problem.Â In motion estimation there are thee three steps, In the first step, the image is divided into a small block of the size16 * 16 pixels. The frame comparison iteratively takes place. Motion Estimation for Video Coding. Yao Wang Polytechnic University, Brooklyn, NY11201. yao@vision.poly.edu. Outline. â€¢ Motion estimation for video coding â€¢ Block-based motion estimation: â€“ EBMA algorithm, Integer accuracy â€“ EBMA algorithm, Half-pel accuracy â€“ Complexity analysis. â€¢ Demonstration â€¢ Use of motion estimation for video coding. Â© Yao Wang, 2005. EE4414: Motion Estimation Basics. Characteristics of Typical Videos. Frame t-1. Frame t. Adjacent frames are similar and changes are due to object or camera motion --- Temporal correlation. Â© Yao Wang, 2005. EE4414: Motion Estimation Basic... Many studies in literature use different block matching motion estimation algorithms in these algorithms full search gives minimum error when compared to the all block matching algorithms this is the basic search but it takes maximum computational complexity. So that in literature survey we find so many block matching algorithms in this block matching motion estimation we have to remember two main things the first one is the type of search pattern this one is the most important one because when the object moving we have to follow the certain pattern then only we can get the minim number of search.Â Block Matching In all video coding standards motion compensation and estimation carried out on 8x8 or 16X16 blocks in the current frame.