International Journal of Computer and Communication Technology

Volume 7 | Issue 4 Article 3

October 2016

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Recommended Citation

CHHOTRAY, SANTOSH KU.; PANDA, MANOJIT; and DASH, SWAPNILA S. (2016) "AN EFFICIENT THREE STEP ALGORITHM FOR FAST MOTION ESTIMATION IN MOBILE DOMAIN," *International Journal of Computer and Communication Technology*: Vol. 7 : Iss. 4 , Article 3.
DOI: 10.47893/IJCCT.2016.1375
Available at: https://www.interscience.in/ijcct/vol7/iss4/3

AN EFFICIENT THREE STEP ALGORITHM FOR FAST MOTION ESTIMATION IN MOBILE DOMAIN

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Abstract- The goal of this work is to find a fast method for motion estimation and motion segmentation using proposed model. Recent day Communication between ends is facilitated by the development in the area of wired and wireless networks. Block matching algorithms are very useful in achieving the efficient and acceptable compression. Block matching algorithm defines the total computation cost and effective bit budget. Recently fast search algorithm for video coding using Orthogonal Logarithmic Search Algorithm (OSA) has been proposed. Motion estimation is the most time consuming operation in a typical video encoder. This paper presents a novel method using three step algorithm with modified search pattern based on dead cell for the block based motion estimation. It has been found that from the original Three step Search (3SS/TSS) method, the PSNR value has increased and the computations and thus computation time (faster) has been reduced significantly .The experimental results based on the number of video sequences were presented to demonstrate the advantages of proposed motion estimation technique.

Keywords- *Video Compression, Motion estimation, Block matching*

I. INTRODUCTION

The need of higher video compression algorithm has escalated due to fastest development in internet and multimedia technology. In order to effectively employ in a limited transmission bandwidth, it is necessary to take control over bit rate requirements and the variable bit rate from motion compensated video needs to be smoothed in addition to very low latencies in end to end communication.

Serving in low bit rate networks like handheld PCs and mobile phones have developed many models for next generation communication devices which is a challenge to many companies. They suffer from today's technical challenges like bandwidth limitation and computation time. So an efficient and effective algorithm is required which can work on low bit rate network and devices with low power sources. So performing motion estimation in real time with acceptable computational time is a major challenge in video compression.
It is worth mentioning that computational time and bit budgeting is principally due to Block matching algorithms used.This paper introduces a new modified block matching algorithm considering above mentioned limitations.This paper is devided into four parts; Part I deals with basic concept of Block Matching: Part II deals with problem definition and solution: Part III deals with simulation result and Part IV concludes the paper.

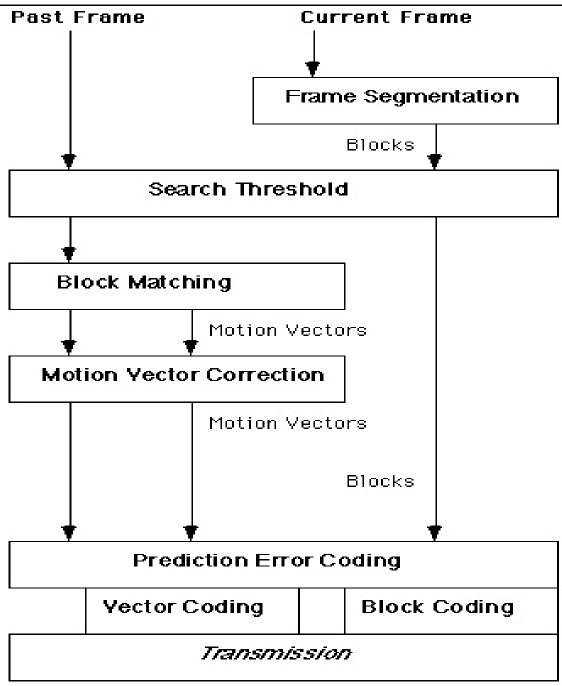

Figure 1:Video Compression Process Flow

II. BLOCK MATCHING ALGORITHMS

In order to take control over volume of data required to describe the sequence block matching algorithm aim at inter-frame compression, known as temporal redundancy. In video compression major work is motion compensation prediction which can be done by motion estimation. In order to perform this frames of moving objects should be tracked first.

The idea behind motion estimation is that the patterns corresponding to objects and background in a frame of video sequence move within the frame to form corresponding objects on the subsequent frame. In block matching current frame is divided into matrix of macro blocks that are then compared with corresponding blocks and its adjacent neighbors in the previous frame. The movement calculated for all the macro blocks comprising a frame, constitutes the motion estimated in current frame Ref.[2].PSNR given by equation-1 is for motion compensated image created by motion vectors.

$$PSNR = 10\log_{10}\left[\frac{(PeakValueOfOriginalData)^2}{MSE}\right] \quad (1)$$

Where
MSE=Mean Squared Error

Pixels in two video frames that have the same values in the same location is generally referred as temporal redundancy. Exploiting temporal redundancy is one of the primary techniques in video compression. An assortment of inter-frame compression methods [1], of various degrees of complexity exist in the literature such as sub-sampling coding, difference coding, and block based difference coding and motion compensation. Motion compensation can be carried out by anticipating the motion of moving objects. Motion compensated prediction assumes that the current picture can be locally modeled as a translation of the pictures of some previous time by comparing the macro blocks.

Block matching methods due to their less computational complexity are the most accepted motion estimation methods which are adopted by various video coding standards such as MPEG-1 and MPEG-2 [9]. In block matching method, the current frame is divided into sub-blocks of N × N pixels. Each sub block is predicted from the previous or future frame, by estimating the amount of motion of the sub-block called as motion vector during the frame time interval. The video coding syntax specifies how to represent the motion information for each sub-block, but computing such vectors are done by Block Distortion Measure (BDM) function. To locate the best matched sub-block which produces the minimum mismatch error, we need to calculate distortion function at several locations in the search range. One of the first algorithms developed for block based motion estimation was the full search algorithm (FSA) also known as exhaustive search algorithm (ESA), which evaluates the Block Distortion Measure (BDM) function at every possible pixel locations in the search area [9]. Although this algorithm is the best in terms of quality of the predicted frame and simplicity, its' computation time is high. In the past two decades, several fast search methods for motion estimation have been introduced to reduce the computational complexity of block matching, some of the algorithms are two dimensional logarithmic search (LOGS) [9], three-step search (3SS/TSS) [2], four step search (4SS) [1]. As these algorithms utilized uniformly allocated search points in their first step, they all can achieve substantial computational reduction with a drawback of modest estimation accuracy degradation. Search with a large pattern in the first step is inefficient for the estimation of small motion since it will be trapped into a local minimum. In real world video sequences, the distortion of motion vectors is highly center biased which results in a center biased motion vector distribution instead of a uniform distribution [9]. This indicates that the probability increases to get the global minimum at the center region of the search window. To make use of this characteristic, center biased block matching algorithms were then proposed with search points much closer to the center which improves the average prediction accuracy especially for the slow motion sequences. Well known examples of this category are New Three-Step Search (N3SS) [2], Advanced Center Biased Three Step Search (ACBTSS) [1], Block-Based Gradient Descent Search (BBGDS) [10], Diamond Search (DS) [10], Cross Diamond Search (CDS) [10], Hexagon-Based Search (HS) [1].

III. DETERMINATION OF DEAD SPACE

A. Problem Definition

Video transmission has gone a long step ahead than audio. In order to be in track with the existing transmission technology considerable research effort has been taken in video compression. The most popular algorithm known in video compression is Three Step Search(3SS/TSS).However 3SS and recently proposed OSA uses uniformly allocated searching points in their first step which becomes insufficient for the estimation of small motions since it gets trapped to local minimum.

Next to 3SS an efficient algorithm termed as DS, very similar to 4SS utilizes a search pattern which gives PSNR close to that of ES with significantly less computational expense.

The proposed algorithm uses a search pattern using 3SS to find local and global minima at the same time at considerable PSNR and reduced computational complexity.

B. Proposed Technique

In this proposed algorithm, we use concept of 3SS with a different search pattern. Without compromising bit budget and quality, the proposed algorithm tries to find optimally the local as well as global minima.

Algorithm:
{
First Step: Step taken from 3SS.
Second Step: Three cases arises
Case-1

If minimum cost is at centre then search with step ize =1(figure-2).

Best possible search.

No third step required.

Case-2

If minimum cost is at any of the axis, then search additional three points with step size=3.(Figure-3).

Case-3

If minimum cost is at any of the corners, then search additional three points with step size=3(Figure-4).

Third Step: It is for getting the local minima from Second step by searching with step size=1.

}

In first step we use 3SS technique with step size=3 in all direction so as to cover a maximum area which helps to get global optimum solution.

In second step we again focus on global optimum solution by searching in three different ways (case-1, case-2, case-3).

In third step we search for local optimum solution in second step.

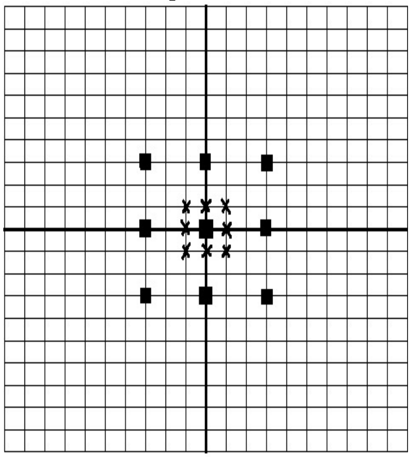

Figure 2:case-1

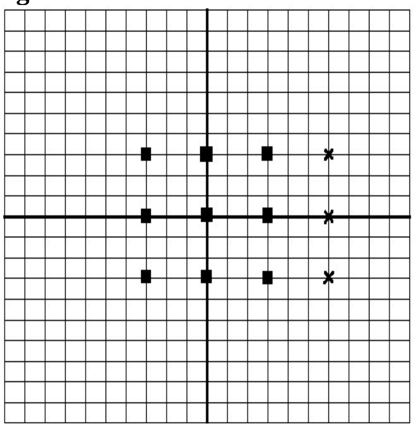

Figure 3:case-2

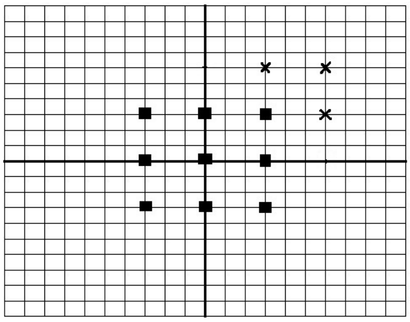

Figure 4:case-3

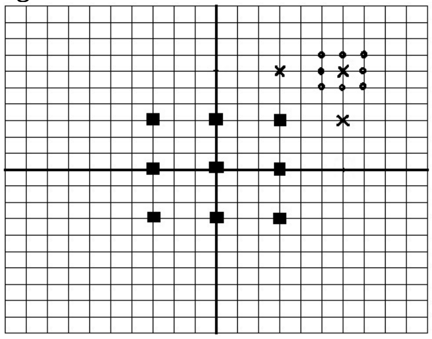

Figure 5:Step-3

III. SIMULATION RESULTS

Table 1: Results for Miss America Frame

S. N	Block Matching Algorithms	PSNR	COMPUTATIO N(sec)
1	NTSS	30.02	22.72
2	DS	25.35	29.74
3	ES	25.60	204.28
4	4SS	25.39	25.09
5	3SS	25.53	23.92
6	Proposed Algorithm	25.52	18.80

Table 2: Results for Foreman Frames

S. N	Block Matching Algorithms	PSNR	COMPUTATIO N(sec)
1	NTSS	14.63	21.82
2	DS	14.02	30.22
3	ES	14.29	204.2
4	4SS	14.07	25.26
5	3SS	14.20	23.87
6	Proposed Algorithm	14.40	18.03

Table 3: Results for Mother Daughter Frame

S. N	Block Matching Algorithms	PSNR	COMPUTATIO N(sec)
1	NTSS	21.22	21.79
2	DS	17.71	29.66
3	ES	17.84	204.28
4	4SS	17.71	24.931
5	3SS	17.77	23.80
6	Proposed Algorithm	18.10	17.90

IV. CONCLUSION

The efficiency of the proposed block matching algorithm has been tested in terms of computation time and PSNR. The result shows a remarkable improvement in terms of PSNR quality and significantly reduced computation time. The comparison table for well known frames clearly reflects the two fold improved characteristics of the proposed algorithm compared to other algorithms developed earlier. The efficiency of this algorithm can be best realized when number of blocks will be reduced.

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