# IMPLEMENTATION OF UMHexagons MOTION ESTIMATION ALGORITHM FOR VIDEO CODING STANDARD

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**Abstract -** Motion estimation (ME) is the most important an d time consuming part of video encoding, it takes about 60%-80% of encoding time. To improve the encoding speed of the UMHexagonS algorithm in x264, an optimized algorithm is proposed in this paper on three aspects via the modified scheme of the threshold selection. The simulation experimentation shows that the proposed algorithms can save about 30% of search points with small video quality decline as that of UMHexagonS algorithm .modified method of the COST MV() function, reduce the numbers of unnecessary MAD calculations and save about 20% to 40% of the estimated time.

**Keywords -** motion estimation; UMHexagonS algorithm; encoding speed

## 1. Introduction

As one of the leading video coding standard, H.264 can reduce approximately 50% bit rate than previous standard, such as MPEG-2, H.263 etc. [1]. Therefore, H.264 becomes one of the research highlights of video coding standard. But, with some new characters were introduced in H.264, such as multi reference frames, bi-prediction model, 114 pixel motion estimation etc. The complexity and computation load of motion estimation increase obviously in H.264 [2]. Motion estimation (ME) is the part of the most computational complexity and the greatest impact on the performance in H.264, which can consume 53% (1 reference frame) to 70.20% (4 reference frames) of the total encoding time of the H.264 codec [3]. So, motion estimation is the key point of H.264 research.

Currently, UMHexagonS (Unsymmetrical-Cross Multi-Hexagon grid Search Algorithm) is main ME algorithm in H.264 standard, based on which some enhanced ME algorithms were developed. The time cost of UMHexagonS algorithm compare with the Fast Full Search algorithm is saving more than 90% in integer pixel motion estimation part, and saving more than 30% in fractional pixel motion estimation part. Meanwhile, a little lower of UMHexagonS algorithm

PSNR compare with Fast Full Search algorithm [4]. However, the absolute computation load and time cost of UMHexagonS is still huge. So, a further optimization for UMHexagonS algorithm between computation load and time cost is needed.

Reducing time consuming of ME is one of the key factors to improve video coding efficiency. In this paper, we propose an adaptive motion estimation scheme to further reduce the calculation redundancy of UMHexagonS. Firstly, new motion estimation search patterns have been designed according to the statistical results of motion vector (MV) distribution information. Then, design a MV distribution prediction method, including prediction of the size of MV and the direction of MV.

## 2. UMHexagonS Algorithm

This algorithm consist of many step, each step uses different search pattern, unsymmetrical-cross search, small diamond search, multi-hexagon-grid search.

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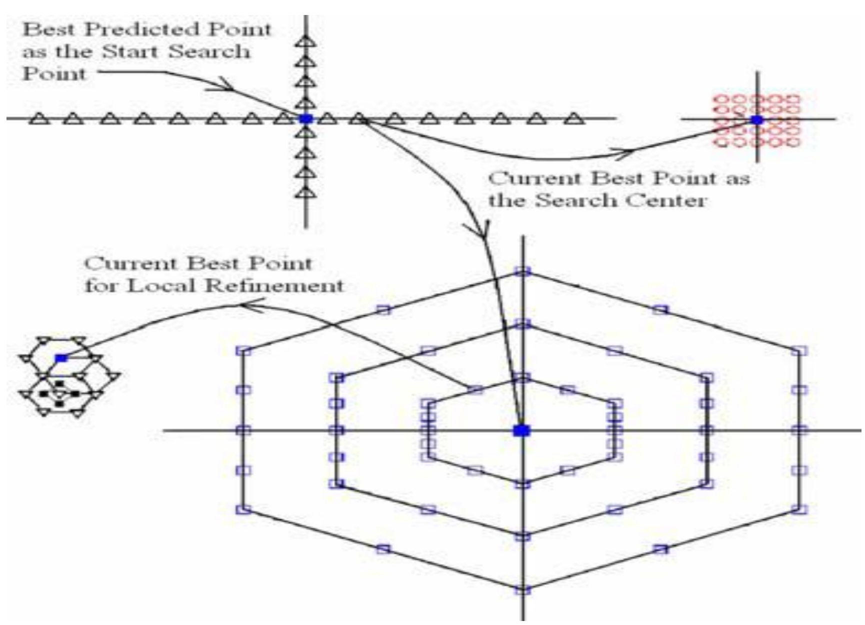
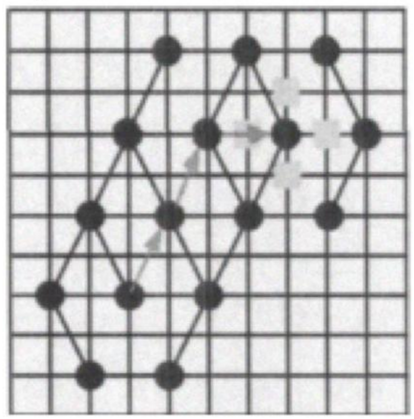




In UMHexagonS, it uses the fixed searching referential window. It is configured by editing the parameter search _ range in the configuration file. In H.264, there are seven different block sizes, the biggest is16 X 16 and the smallest is 4X4. The size of referential window is decided by the parameter search _range , the size is(2 * search _ range + 1) * (2 * search _ range + 1), the total search points ( SP _ number) are calculated by equation 1.

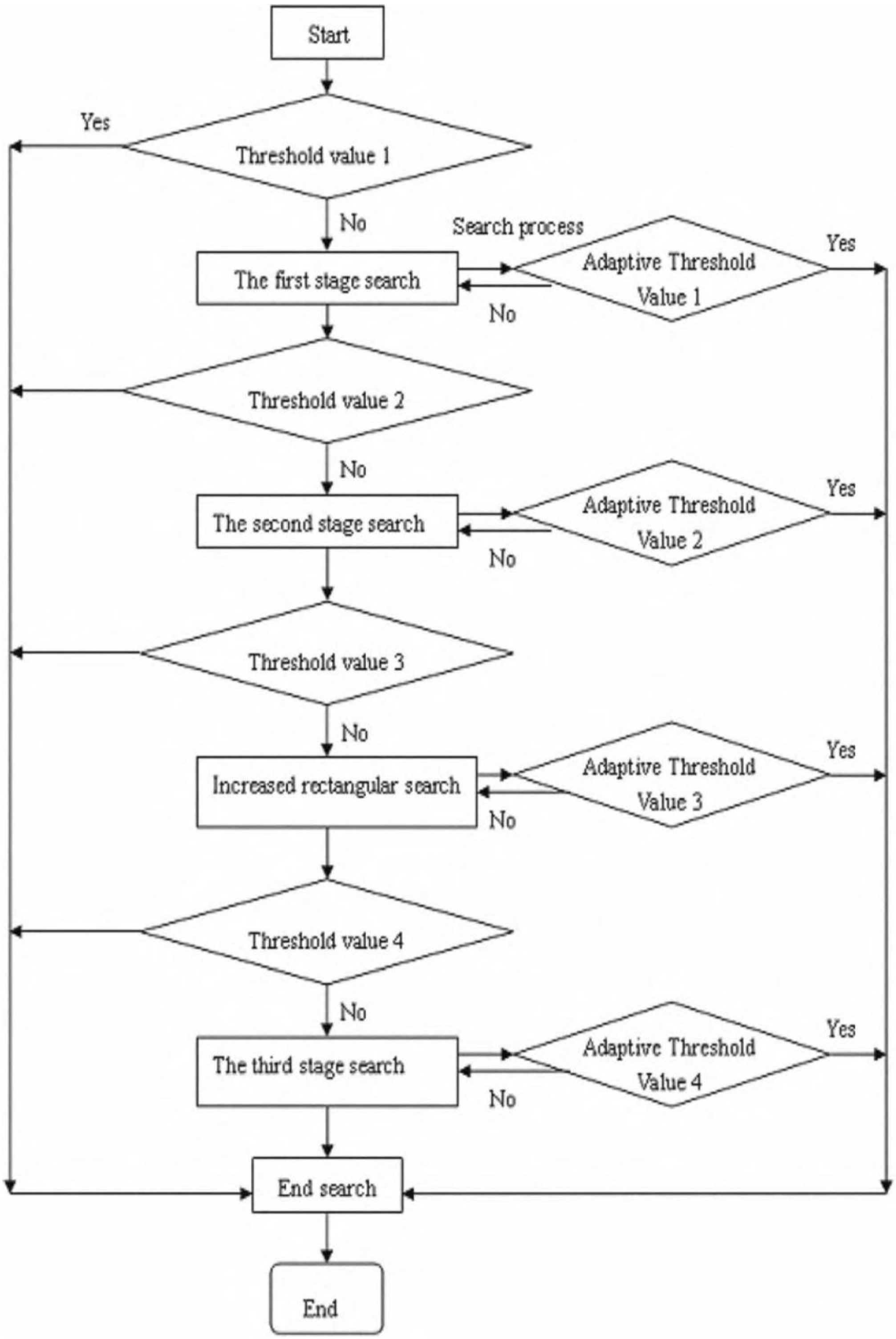
SP _ number = (2 * search _ range + 1)2 (1).

## 3. Umhexagons Algorithm Optimization

In this paper we improve the algorithm from two aspects: The first aspect is after achieve the desired results, early end the search, this step we will search through every link, Adaptive threshold setting, And in the course of each search will compare value with the threshold, If the conditions are met, then the search ahead of deadline, this will greatly save the search time.

The second aspect is through the search range and methodology changes to reduce the search time, because the level of activity than the vertical image direction of activity to be a little more, and the first two phases of the search is very fast, so we will not get the first two stages where the desired results, add a large horizontal rectangle search step.

This paper proposed the improved algorithm search process shown in Fig.


Start
Threshold value 1
Yes
No
Search process
The first stage search
Adaptive Threshold Value 1
Yes
No
Threshold value 2
No
The second stage search
Adaptive Threshold Value 2
Yes
No
Threshold value 3
No
Increased rectangular search
Adaptive Threshold Value 3
Yes
No
Threshold value 4
No
The third stage search
Adaptive Threshold Value 4
Yes
No
End search
End

## 4. Experimental Results And Analysis

The experimental environment is: Windows XP operating system, MATLAB software. We compared and analyzed through the validation of the coding sequence of time, motion estimation time and PSNR as the goal. As shown in table I.

| Test Sequence | MET(S) | PSNR(dB) | COMPUTATIONS |
|---|---|---|---|
| BQmall | 22.59 | 24.67 | 12.08 |
| Foreman | 71.03 | 22.23 | 11.03 |

**Table: 1 Comparison PSNR, MET, Computations**

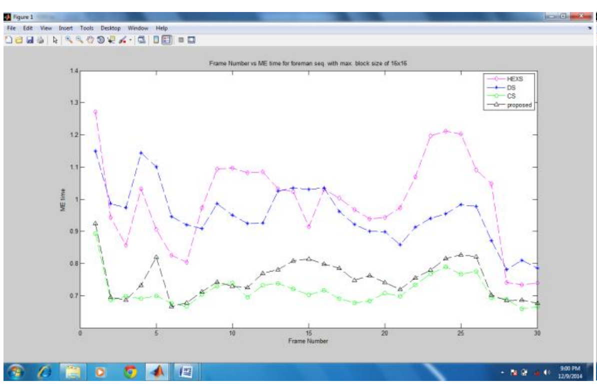



**Fig 1: Motion Estimation Time**

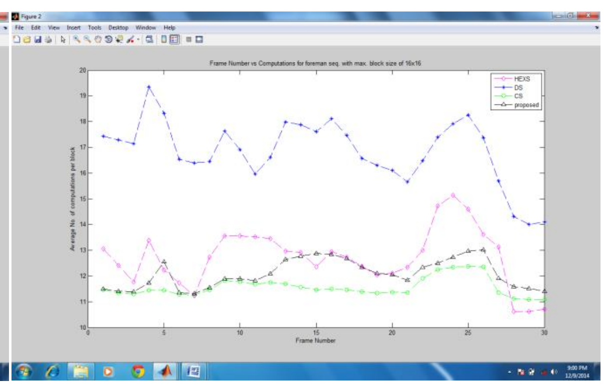
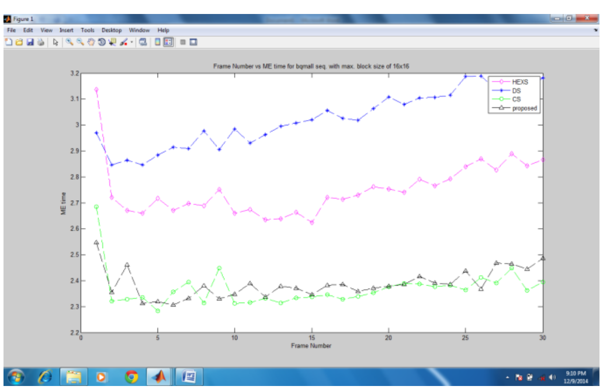



**Fig 2: Number Of Computations**

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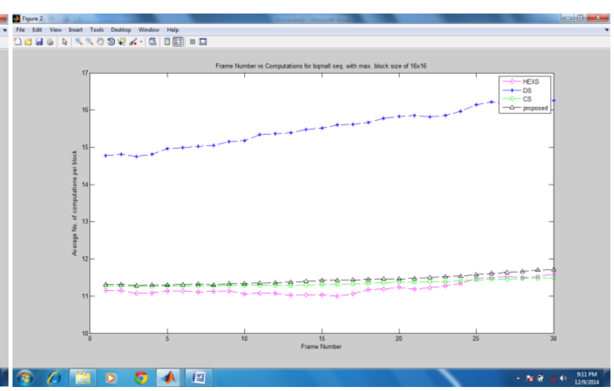


**Fig 2: Number Of Computations**

## 5. Conclusions

Motion estimation is a very important part of the H.264 standard and it directly affects the quality of image coding and coding speed. This paper has carried on a certain research discussion about UMHexagonS of the H.264 algorithm, and proposes the improved motion estimation algorithm optimization based on the original algorithm. The improved algorithm has less effect in the motion estimation accuracy and image quality, greatly reducing the original algorithm unnecessary search points, thereby reducing the encoder end of the campaign estimated time consuming, and improve the encoder code efficiency.

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