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An Improved Adaptive Rood Pattern Search for Motion Estimation

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Abstract. Block matching is one of the computationally demanding aspect of video encoding process. In many applications, real-time video encoding is desired and therefore it is important that the encoding is fast. This study appraises a two-tier technique involving the block matching algorithm, Adaptive Rood Pattern Search, which is used in video compression today and Slantlet Transform which is used to increase the sensitivity and accuracy of the matching algorithm. This study also utilizes a conventional block matching algorithm, Exhaustive Search in order to compare the proposed technique in terms of point searched performance and peak-to-signal noise ratio value. The aim of this study is to propose a block-matching algorithm that improves the motion estimation for video codings. to determine the effectiveness of Slantlet transform in improving the result of the computational time and peak-to-signal-noise ratio (PSNR) value and to evaluate the performance of the proposed two-tier technique towards the accuracy of motion estimation recognition. The result of this study shows that Adaptive Rood Pattern Search is better in term of performance than Exhaustive Search with Slantlet Transform improves the accuracy of the result obtained.

Keywords: Adaptive rood pattern search, block-matching algorithm, motion estimation, peak-to-signal noise ratio, search points, slantlet matrix.

1 Introduction

Motion Estimation (ME) is an important part for video codings, which can effectively remove temporary redundancies among the adjacent video frames to achieve high coding efficiency. Block matching algorithms for motion estimation have been applied by the latest video codings such as MPEG-1, MPEG-2, MPEG-4 and H.264 due to it being effective. The most conventional block matching algorithm used is known as the Exhaustive Search (ES), where it obtains a motion vector by exhaustively searching all the possible location in a given search area (Zhao *et al*, 2008). Exhaustive Search (ES) would yield a very high computational time and PSNR which in terms limits its use in a real-time video applications. Therefore, by using a fast block-matching algorithm would prove to be reducing the computational cost especially in term of computational time. Based on the assumption that motion estimation matching error would decreases monotonically as the search moves toward the position of global minimum error, the motion vector of each block is searched individually by using a fixed set of search pattern.

2 Improved Adaptive Rood Pattern Search

The proposed technique requires four components: i) Conversion of videos into readable compression format, ii) Implementing both Exhaustive Search (ES) and Adaptive Rood Pattern Search (ARPS) algorithms on the video frames, iii) Applying Slantlet Transform (SLT) to both algorithms and iv) Comparison of the performance of the algorithms.

The proposed scheme begins with pre-processing of the video files. The selected videos are converted into images frames and the frames are then converted into grayscale images. The first step of the pre-processing phase is to convert the video file into an array of image frames. The video file acquired from SULFA datasets are selected and converted into array of image frames. After the video file has been successfully converted into image frames, the next step would be to convert the RGB frames into grayscale frames. By converting the video into sequences of image frames, the images are divided into non-overlapping block to make it easier for block matching algorithm to be applied. But before applying the block-matching algorithm into the frames, the set of frames would need to be initialized for its macroblock size (mbSize) and search window size (p)

The first step would be to compare and evaluate the performance of the block matching algorithms proposed in this study where an initial experiment involving the Exhaustive Search and Adaptive Rood Pattern search is conducted. Both algorithms are implemented into the datasets and results are gathered using the matching criteria, average point searched and average peak-to-signal noise ratio. In order to evaluate the performance of the proposed two-tier technique, the results gathered from the initial experiment are compare with the dataset implemented with Adaptive Rood Pattern Search and applied with Slantlet Transform. The results obtained are then compared and evaluated.

3 Result

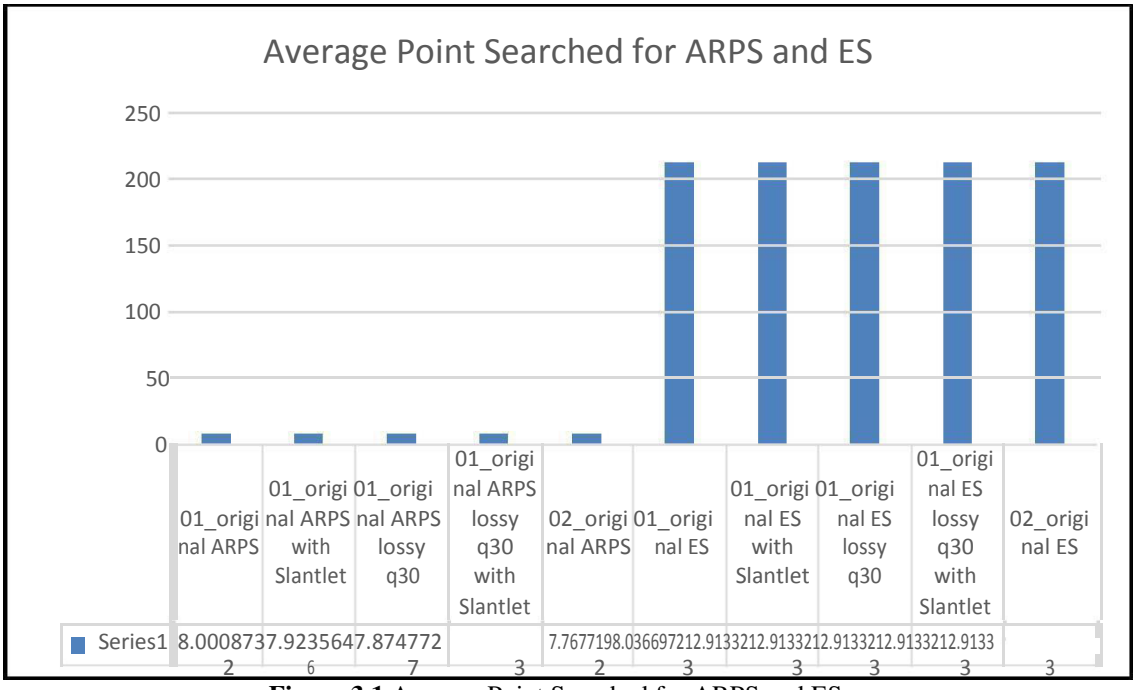

Figure 3.1 Average Point Searched for ARPS and ES.

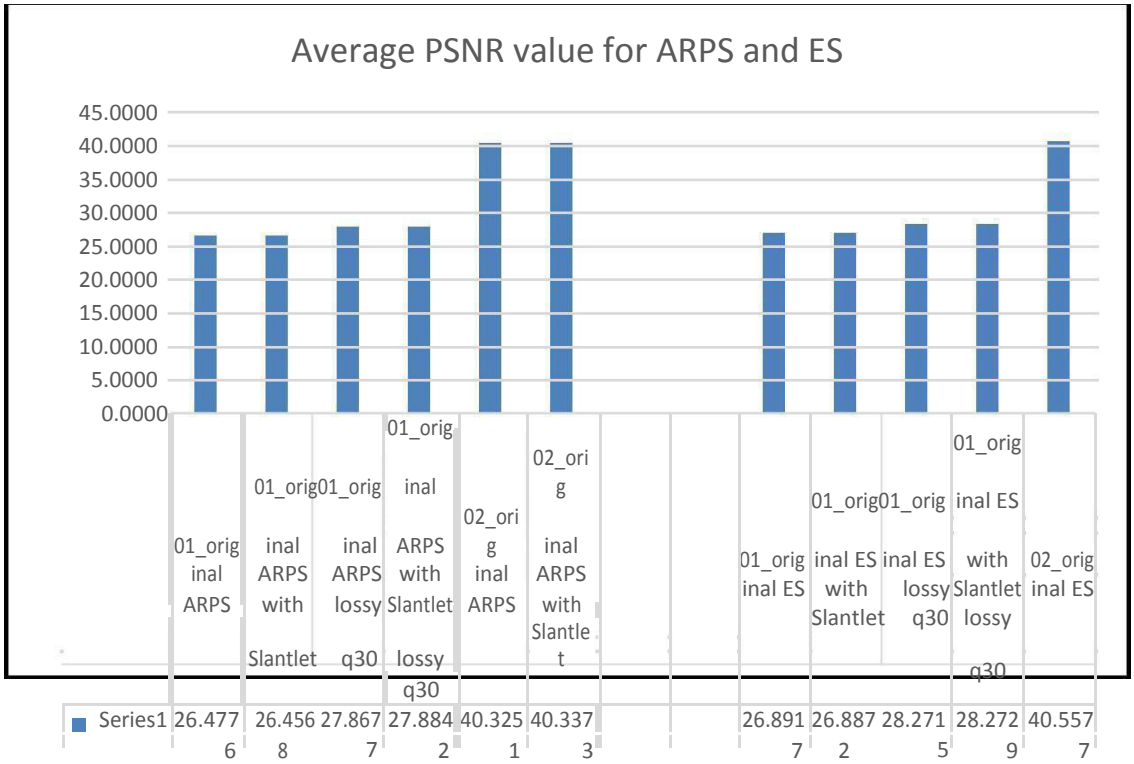

Figure 3.2 Average PSNR value for ARPS and ES.

Figure 3.1 and 3.2 shows the initial results of the performance between Exhaustive Search and Adaptive Rood Patter Search. Figure 3.1 shows the average point search for both ARPS and ES. As shown in the graph, ES has the highest computational time while ARPS has the lowest. Another point that can be seen is that all of ES computational time have the same value. This is because, ES searches all probabilistic similarity (Razali *et al*, 2013) and as for ARPS, the computational time differs only if the quality of the video and the amount of movement detected in a video is different

Figure 3.2 shows the average peak -to-signal noise ratio (PSNR) value. From the graph generated, ARPS have the lower average PSNR compared to ES. This result clearly shows that ARPS is better than ES in terms of performance.

Figure 3.3 shows the average point search of ARPS with SLT and without SLT. As can be seen in the graph, the computational time is lower where SLT is applied. This is because, the SLT reduces the MAD computation and in terms reduces the computational time.

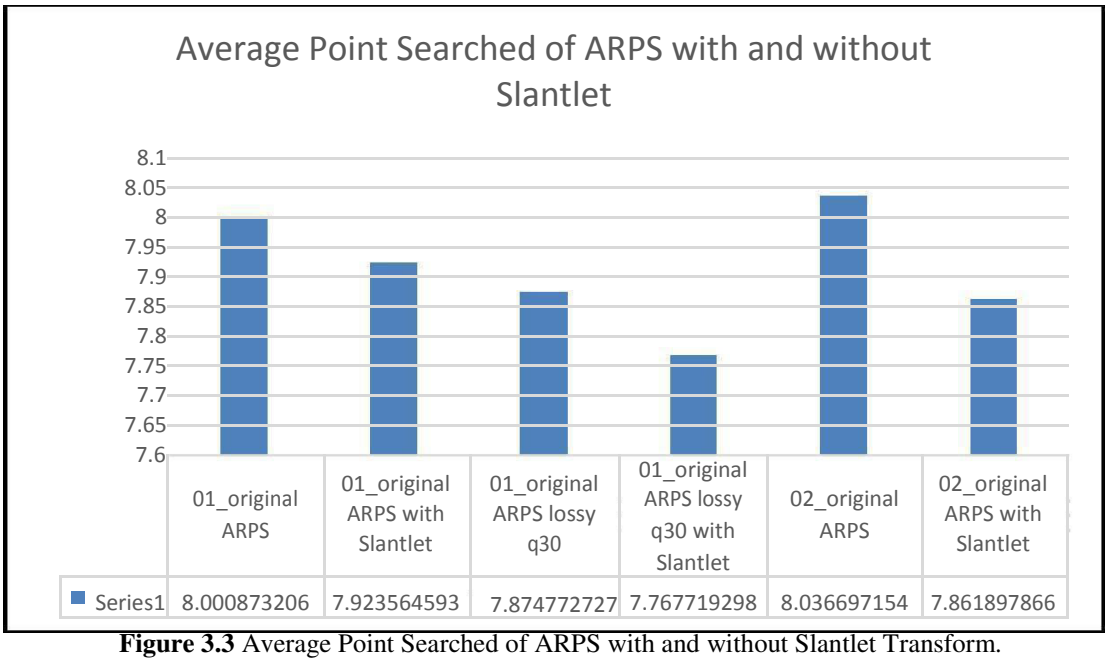

Figure 3.3 Average Point Searched of ARPS with and without Slantlet Transform.

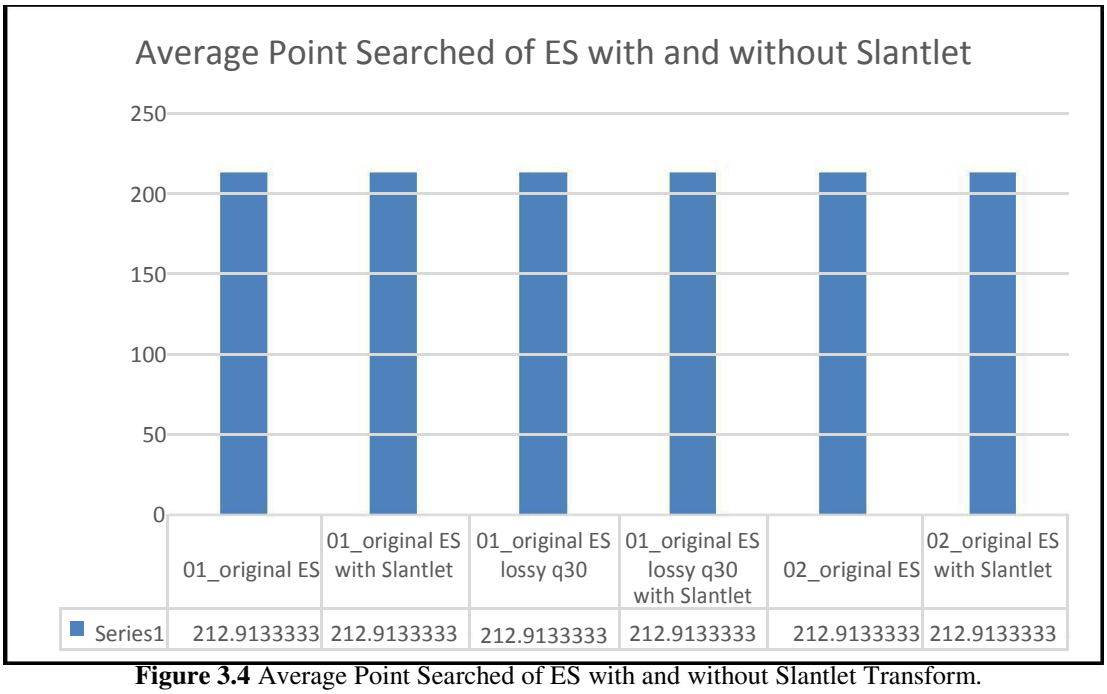

Figure 3.4 Average Point Searched of ES with and without Slantlet Transform.

Figure 3.4 shows the average point searched for ES with SLT and without SLT application. The results have the same value because ES algorithm search by checking all the points in the frame (Razali *et al*, 2013). This result act as a prove that ES have the longest computational time.

Figure 3.5 and Figure 3.6 shows the average PSNR value for both ARPS and ES respectively. Both figures show that the application of SLT increases the PSNR value this would justify that SLT improves the performance of block

matching algorithms. Another point is that ES have lower PSNR value than ARPS which would prove that ARPS have a better performance than ES.

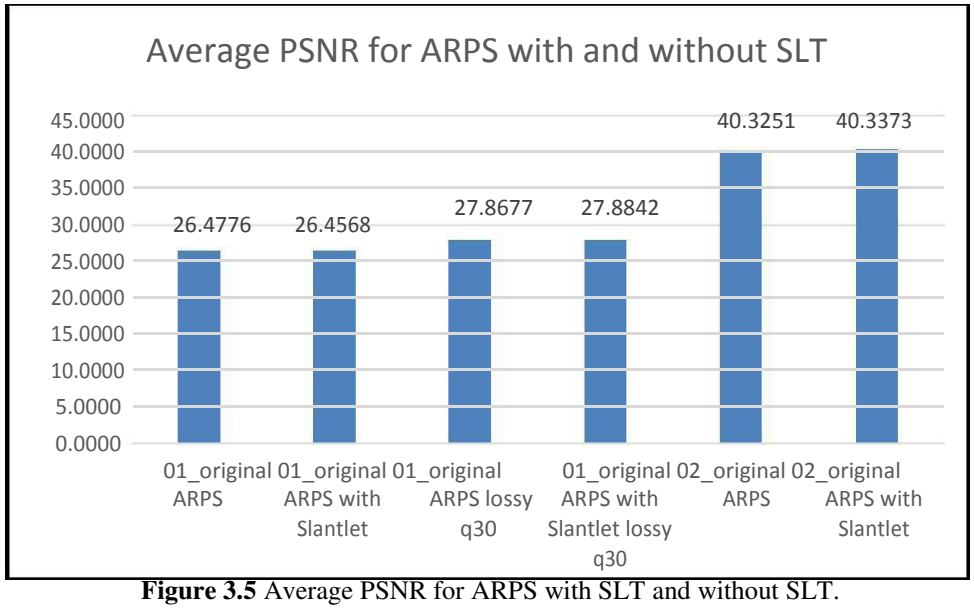

Figure 3.5 Average PSNR for ARPS with SLT and without SLT.

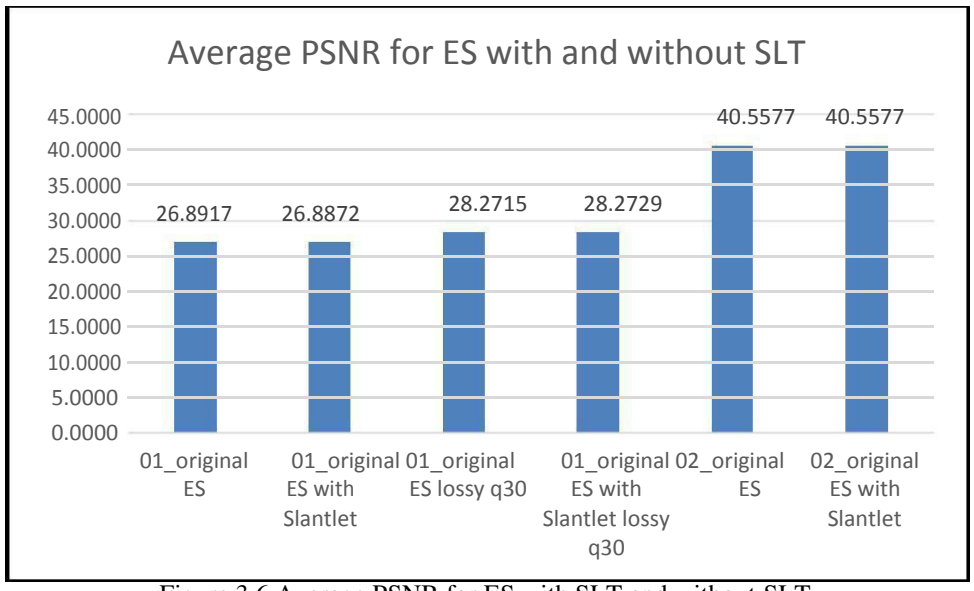

Figure 3.6 Average PSNR for ES with SLT and without SLT.

4.0 Conclusion

As the main goal of this study is to investigate the effectiveness of the proposed two-tier technique consisting of Adaptive Rood Pattern Search (ARPS) algorithm and Slantlet Transform (SLT) in improving motion estimation in video codings, which is supported from the results obtained in chapter 4, where it is proven that Adaptive Rood Pattern Search (ARPS) have a better performance than Exhaustive Search (ES) in terms of both computational time (point searched) and peak-to-signal noise ratio (PSNR) value. The results are improved with the

application of Slantlet Transform (SLT) where ARPS still have a better performance than ES. The application of SLT can also be used to improve the accuracy and reduce the computational time as depicted by the results obtained in chapter 5. This would satisfy both the first and second objective of the study which in terms completes the goal of the study.

References

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