CHAPTER 07
CONCLUSION AND FUTURE SCOPE

This chapter concludes the thesis by summarizing the main developments and results of this work, and by indicating directions for further research.

7.1 CONCLUSION

As the Internet is more and more universal and the technology of multimedia has progressed a lot, the communication of the image data is a part of life. In order to employ effect in a limited transmission bandwidth, to convey the most, high quality user information, it is necessary to have more advanced compression method in image and data. Motion Estimation (ME) and Compensation techniques, which can eliminate temporal redundancy between adjacent frames effectively, have been widely applied to popular video compression coding standards such as MPEG-2, MPEG-4. Motion estimation generates motion vectors that represent the movements of image blocks between successive frames. Motion estimation is conceptually quite simple, and it allows a very large reduction in the video bit rate. However, it often requires considerably large part of the computation in video encoders. This research has addressed the developments in motion estimation techniques for image sequence coding applications. Block matching motion estimation techniques have been chosen as the baseline of this study due to their suitability for coding applications.

The thesis focused on the computational complexity and performance trade-offs offered by some of the well known fast motion estimation algorithms in a video coding scheme such as Full Search Algorithm, Three Step Search Algorithm, Two Dimensional Logarithmic Search Algorithm, Cross Search Algorithm and One at a Time Algorithm. New One at a Time Algorithm and Modified Three Step Search Algorithm is proposed with modification. The New One at a Time Search (NOTA) is a very simple but effective algorithm. Experimental results show that
proposed technique provides competitive performance with reduced computational complexity. An efficient Modified Three Step Search Algorithm was presented. The search strategy of M3SS performs much better than 3SS and FS algorithm. Qualitative performance of M3SS in terms of average SNR doesn’t show significant variation from FSA and 3SS algorithms. This analysis is useful for selecting appropriate algorithms for variety of video coding applications that require an optimal trade-off between computational complexity and quality of video.

It has been observed that 3SS and recently proposed OSA uses uniformly allocated searching points in their first step which becomes inefficient for the estimation of small motions since it gets trapped into local minimum. Having observed this problem, a novel Modified Orthogonal Search Algorithm (MOSA) is proposed in this thesis. The proposed MOSA searches the additional central eight points in order to favor the characteristics of center biased motion. To speed up block matching process, MOSA terminated at intermediate step instead of adapting the entire steps of the algorithm referred as half way stop technique. This feature improves the speed performance of the algorithm by 80% as compared to the Full Search Algorithm, 50% over the Three Step Search algorithm and 2% faster than the OSA. The proposed Modified Orthogonal Logarithmic Search (MOSA) in block motion estimation results in the significant speed gain over 3SS and FSA. The strength of MOSA algorithm lies in its speed of operation. Owing to its ability of reducing complexity, we recommend MOSA for efficient hardware implementation.

The wide range of multimedia applications based on video compression (video telephony, video surveillance, digital television) leads to different kind of requirements for a video coding standard (image quality, compression efficiency). Several multimedia application areas require high power efficiency (especially in the video encoder part) in order to work on embedded systems and mobile terminals. This requirement implies the need to dramatically reduce the complexity of the video encoder. Algorithmic analysis shows that motion estimation is
the most complex module in the video encoder. This is mainly due to the
great number of calculation in motion estimation. Having this in mind,
we proposed dynamic motion detection techniques for fast and efficient
video coding. Dynamic motion detection is an innovative algorithm for
motion estimation and complexity reduction, based on active motion
detection. A classifier based on the frame variance and correlation has
been employed to detect an active and an inactive blocks. Additionally
the threshold value in the algorithm is calculated automatically which
avoids user interaction. It has been experimentally proved that the
majorities of the blocks within a frame are inactive and can be taken
with zero motion vectors. As a result we saved measurable
computational time required for motion vector estimation for these
blocks. The result shows that this proposed scheme can simplify the
encoder complexity, maintaining high compression rate and good video
quality.

Owing to inherent simplicity, both in terms of hardware and
software implementation, block based methods have always been
employed for motion estimation. Employed sum of absolute or squared
errors in block matching algorithms are not absolutely desirable as block
distortion metric. In these criteria all pixels have identical importance
and the spatial spread of distortion is not considered. It has no way to
detect or follow the real moving contours existing in the scene and hence
has shortcomings like unreliable motion vectors, block artifacts, and
poor motion-compensated prediction along the moving edges. In this
thesis a new search strategy based on edge detection is proposed to
obtain more accurate motion prediction along moving edges. For edged
block motion estimation, edge boosting distortion function based on
Ridgelet transform is used which is a powerful tool in representing edges
and discriminating it from background. Projected block motion
estimation algorithms those using edge matching, ensures the better
motion-compensation prediction along moving edges. The poor
prediction along the moving edges, which is very annoying around
moving objects, is substantially reduced by the proposed algorithm.
One of the important factors that determine the performance of a block matching motion estimation algorithm is distortion criteria. Most video coding standards prefer mean absolute difference criterion and do not consider the orientation of pixel in different directions and therefore fails to find the best match using only pixel differences. In general way, an image may be segmented into two kinds of areas; structure and texture, former being more important than the later. Natural images are generally structure dominant in which structure of the visual scene carries most of the information about the objects. Structural information has a direct bearing on, pixels, edges and shape with directional characteristics. The distortion of the structural information could be modeled as the alteration of the directional characteristics. In this work the directional characteristics, based on the Radon transform are used for directional projection vectors. Our criterion appears to compare, favorably with existing mean absolute difference criterion, with increased computational complexity. Further improvement in the radon projection matching criterion may be possible with increase in number of projections. It should be noted that the projected criterion performs well for most of the video sequences and can be used with any conventional block matching algorithm.

7.2 DIRECTIONS FOR FUTURE SCOPE

In future, other evolutionary computing techniques also can be tried for the better results. Three important factors like block size, search area and distortion metric can be thought for improvement in the performance of Video Coder. Such as variable block size, large search area for complex motions and small search area for less complex motions.

The distortion between the original and compressed video sequences is typically evaluated as a mathematical error measurement, e.g., MSE, even though this type of measurement does not correlate well with perceptual quality and cannot lead to subjective optimal decisions. Therefore, objective distortion metrics considering perceptual quality,
especially content-adaptive perceptual quality, are meaningful. The distortion metrics will play an important role in future video compression algorithm. Different acceptance rejection criteria can be set for different blocks during the matching process.

Multiresolution technique is a good candidate for intraframe coding which is based on human visual perception. This may be computationally complex in today's scenario but looking into the growing research in computer architecture this can be utilized in Video Coder.

New algorithms in motion estimation, segmentation and tracking could be thought to allow coders to selectively transmit the only "interesting" parts of the video signal. In this respect, a lot of research can be carried out in order to stabilize the existing techniques and to further investigate the human perception of images. One could then conceive algorithms that are able to automatically characterize the content of images. The challenge of the new ISO MPEG-7 work item is here of great interest.

It is to be seen that, the extent to which adaptability, context modeling and other strategies can be developed into mature algorithms to compress video more efficiently than today's standardized coders. Future video compression algorithms may employ more adaptability, more refined temporal and spatial prediction models with better distortion metrics.

The cost to users is the significant for implementation complexity at both the encoder and decoder. Fortunately, it seems that bitrates have a slower doubling time than computing power, so the disadvantage of increasing implementation complexity may one day be balanced with much improved processor capabilities. Due to the advancement in the integration technology, designing of specialized processors for video compression can be thought of.

Although the imminent death of research into video compression has often been proclaimed, the growth in capacity of telecommunications networks is being outpaced by the rapidly increasing demand for
services. The result is an ongoing need for better multimedia compression, and particularly video and image compression. At the same time, there is a need for these services to be carried on networks of greatly varying capacities and qualities of service, and to be decoded by devices ranging from small, low-power, handheld terminals to much more capable fixed systems. Hence, the ideal video compression algorithm should have high compression efficiency, be scalable to accommodate variations in network performance including capacity and quality of service, and be scalable to accommodate variations in decoder capability.