ABSTRACT

The emerging home-networks and broadband convergence network technologies allow people to watch images and videos anywhere and anytime. The display devices can be a large plasma display panel, a standard definition TV, or a very small cell-phone. Consequently, the video codec used in these devices should support various displays with different resolutions. Hence, there comes a high demand for an efficient video coding technique which can provide an acceptable quality for very low bitrate and support new functionalities such as peak signal to noise ratio (PSNR), frame rate and spatial scalability. Moreover, system should have good potential to carry spatial and temporal scalability, which are considered to be most essential for the new multimedia and video surveillance applications.

In this thesis, four different, fast and accurate video compression techniques are introduced to assure much reduced processing delay, while maintaining good reconstruction quality. Basically, video signal has temporal redundancies due to high correlation between successive frames. Current systems fail to exploit the significant temporal redundancy in the video frames to improve compression efficiency. However, they are ineffective in maintaining high compression ratio, high gain and coding time. Hence, an attempt has been made in the proposed algorithms to improve the performance of video compression system.

In general, set partitioning in hierarchical tree (SPIHT) algorithm, is progressed as the strong contender to surmount the above said deficiencies.
Nevertheless, SPIHT algorithm requires hefty time, causing delay in real time video transmission and occupies large amount of bandwidth. Weighted adaptive scalable hierarchical (WASH) tree based video coding algorithm with low memory is proposed in this work to increase coding efficiency. PSNR and coding times are the measurable parameters considered to analyze the performance of the algorithm.

Normally, video signal has high temporal redundancies due to soaring correlation between successive frames. In fact, current video compression techniques fail to expose these types of redundancy in an efficient manner. Scalable accordion discrete cosine transform (ACC-DCT) exploits the significant temporal redundancy in the video frames and a technique using up/down sampling approach is proposed to improve compression efficiency. This technique explores the temporal redundancy of the video and also avoids the computationally demanding motion compensation step. Also, several experimental tests at high bit rate and slow motion video are conducted to analyze the system efficiency in terms of PSNR, compression ratio and coding time.

Speeding up of the process is a major constraint in video compression standards and block based motion estimation is extensively used for exploiting video temporal redundancy. Consequently, large number of fast block matching algorithms (BMAs) has been anticipated for motion estimation by limiting the number of search locations. A novel BMA that measures the match using Fast Walsh Search-Least Median Square (FWS-LMedS) based approach for motion estimation is also proposed in this work. For early rejection of mismatch candidates, target blocks in the current frame and their contenders in the reference frame are transformed into Walsh-Hadamard coefficients. Robust LMedS measure is used as cost function in
minimizing the squared differences between the current and predicted frames. In addition to small computation requirements, providing high matching accuracy is the major contribution of the proposed matching algorithm.

Moving edge detection and tracking is also proposed for efficient video compression. This technique is based on background model which is automatically generated by a modified Kohonen based self organizing mapping method. Static edges provide a hint for the boundary of object and furnish information over moving objects. Using the knowledge of moving regions, it allows complexity reduction in motion estimation. Qualitative results are obtained through the proposed method to detect true moving edges. Further, evaluation of the proposed approach reveals high PSNR, precise detection accuracy and greater processing speed.

Results derived from the simulation of the proposed algorithms have high PSNR, improved visual quality with overall compression efficiency. Furthermore, these techniques speed up the encoder with negligible changes in bit rate. Also, the proposed techniques are highly flexible. In addition, possible directions for further developments are outlined.