ABSTRACT

Video coding standards have attracted much attention worldwide recently with an increasing number of very large scale integration (VLSI) and software implementation of these standards becoming commercially available. In video encoders, motion estimation is used to remove interpixel redundancy between frames and block based motion estimation algorithms are mostly used in literature for their simplicity. In such algorithms, video frames are divided into fixed/variable size blocks and each block in the current frame is searched for a best match block in the reference frame in a given search window. Various types of block matching criterions like mean square error (MSE), mean absolute error (MAE), normalized cross correlation function (NCF), etc. have been discussed in literature, but MAE is being used in most of the video coding standards due to its low computation and simplicity. In large motion video inputs with contrast variations, it has been found that MAE does not produce good results. Further, due to the commercialization of real time multimedia based applications like video on demand, video conferencing etc., reduction in computation cost of motion estimation has become critical requirement. Therefore, in last few years, it has been a challenge for researchers to design accurate block matching criterion and efficient motion estimation algorithm for encoding of video signals.

In this thesis, a robust pixel mapping based block matching criterion has been proposed and its performance has been compared experimentally with three other existing block matching criterions: MAE and its variants – vector matching criterion (VMC) and smooth constraint mean absolute error (SC-MAE) in terms of various performance parameters like average error/pixel, average search points/block, average peak signal to noise ratio (PSNR) per frame, average bits/pixel value and execution time. A reduction of nearly 75% in average error/pixel and an increase of 16% in PSNR (dB) have been observed for proposed criterion in comparison to conventional MAE. In terms of aver-
age bits/pixel, there is a reduction of 37% whereas for \( \frac{Quality}{Compression} \) ratio, an increase of 80% has been observed for proposed method than conventional MAE.

Block matching criterions using integral frame concept are faster. Integral frame representation reduces the computation cost drastically but such techniques suffer from the drawback of spurious block matching possibility. In this thesis, a multilevel block matching criterion using integral frame concept has been proposed to reduce this drawback. Proposed criterion has been experimentally compared with conventional MAE along with another criterion which is based on integral frame representation and it has been found superior by 12% in terms of average PSNR per frame with respect to the block matching criterion using integral frame whereas this PSNR value is found to be almost same to that produced by conventional MAE criterion.

Motion estimation is the most time consuming step in a video encoder and it is always desirable to minimise this time preserving video quality as good as possible. To meet the challenge of reduction in computation cost for block based motion estimation, a dynamic pattern search (DPS) based motion estimation technique has been proposed which adapts its shape and size based on the magnitude of motion vectors of spatially and temporally adjacent blocks. It is based on the observation that blocks have strong spatial as well temporal correlation among themselves. Proposed algorithm has been compared with two other motion estimation algorithms – diamond search (DS) and hexagonal search (HS) and an speed up of nearly 104% and 39% in terms of average search points/block with respect to DS and HS techniques respectively has been achieved for the proposed technique, preserving almost same quality in terms of PSNR (dB). Further, DPS has also been evaluated using other parameters like average bits/pixel and \( \frac{Quality}{Compression} \) ratio and very favourable results have been obtained for the same. To further increase the speed of DPS, it has been modified and its modified form has been found to be 29% faster than its original version.