Multi-Fractal Analysis for Video Compression

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Abstract

Schemes for digital video compression are paramount importance in today's wireless telecommunication and multimedia system where bandwidth is a valuable commodity. A common approach to the color video compression is started by extracting the frames from the input video stream and applying intra-frame coding on the reference frames and inter-frame coding is applied on the in-between frames. So, the aim of this dissertation is to implement an efficient Inter- and Intra- Frame coding scheme that removes the temporal and spatial redundancies occurred respectively.

The proposed Inter-Frame Coding Scheme (Inter-FCS) utilizes the block descriptor to facilitate the block-based motion estimation search that entitled Descriptor Based Search (DBS). It consists of three phases: descriptor calculation phase, single value matching and selection phase and block distortion measurement a computation phase .According to the number and type of the descriptor used, the DBS is partitioned into two approaches: Triple-DBS and Quad-DBS.

Triple-DBS approach uses the mean, standard deviation and moment around x-coordinates as block descriptors. Triple-DBS compared with the well-known Exhaustive Search (ES) and Three Step Search (TSS) algorithms, the test results showed that it produces more accurate results than TSS and near ES accuracy but in term of time still TSS is faster.

Quad-DBS approach uses the block in more details (i.e. the block is partitioned in to four quarters and the total of each quarter is computed) to produce four descriptors. The first descriptor is mean, the second one is the average of upper versus lower quarters total, third is the average of left versus right quarters total and forth the average of main versus secondary diagonally quarters total. The test results showed that Quad-DBS error accuracy improved by (0.015%) and the time reduced by (0.025%) than TSS. The attended accuracy is closed to ES accuracy. That result was encouraging to study the effect of the Proposed Distortion Measurement (PDM) and the speeding up version of PDM (SPDM). The test results showed that it leads to encouraging results in term of error and time. The error accuracy improved by (0.175%) and the time improved by (0.711%) than ES, video sample foreman taken as an example, but still the TSS is faster by (0.23%).

The proposed Intra-Frame Coding Scheme (Intra-FCS) is based on Fractal Image Compression (FIC). The proposed FIC uses quadtree as variable range block partitioning mechanism. Two criteria'sfor guiding the partitioning decision had been used: the first entailed Proposed FIC using Sobel as partitioning scheme (PFICS) and the second entailed Proposed FIC using uses max variance within the block as partitioning scheme (PFICV). Three moment combinations had been proposed and their effects were tested with variable and fixed range block partitioning mechanism. The PFICS and PFICV produced balanced results in comparison with the of fixed partitioning that symbolized by PFICL (where L=4 or 8). The test result referred that PFIC4 produced good results in term of quality but in term of compression ratio (CR) and encoding time, PFIC8 is the best. The test results showed that the PFICV improved the CR by the ranges: [11.41%-27.64%], [48.61%-61.30%] and [14.41%-47.46%] for Tennis, Chair and Lena test mages. The test results showed that the PFICS improved the CR by the ranges: [14.08%-30.37%], [48.55%-60.86%] and [2.56%-24.10%] for Tennis, Chair and Baboon test mages. So PFICV and PFICS results can be considered balanced results, and they are better than PFIC4 in term of CR, faster than it and comparable in term of PSNR.

Another proposal had been investigated by engaging FIC with wavelet transform that symbolized by (PFICW), where the fractal is applied on LL band, while the other bands (LH, HL and HH) had been quantized and the empty regions removed using quadtree. The resulted data buffer is coded using shift coding. The test shows that the PFICW produces better result for cases of images convey high frequency components (like Baboon) but for images have a lot of low frequency components the introduced PFIC can lead to acceptable results.