Abstract

MPEG-2 video encoder generates variable bit rate at its output. This is due to the variations in compression achieved depending on the complexities of the scene and the variable length coding. However, in applications like digital TV broadcasting over satellites, the encoder output has to be transmitted over constant bit rate (CBR) channels. Hence, a buffer is required to provide a constant bit rate output. This buffer should be of a reasonable size to avoid unacceptable buffering delays and buffer overflows. Moreover, it should not be allowed to overflow or underflow, as it will affect quality. This is achieved by suitably controlling the quantisation step of the encoder and the techniques used for this are called rate control techniques. MPEG-2 committee has proposed a Test Model5 (TM5) in which a typical rate control technique is described. However, it is not mandatory to use the same and hence better rate control techniques can be developed and deployed in encoders while still complying with the MPEG standard.

In real time systems, like remote sensing systems onboard satellites, the use of JPEG compression technique results in variable bit rate. For transmission of this data over a CBR channel, there is a need for buffering the output of the compression system. In order to avoid buffer overflow and underflow conditions, rate control techniques are required.

In this work, rate control techniques for MPEG-2 video and JPEG images have been developed, implemented, and their performance studied. For MPEG-2 video, the rate control technique proposed in TM5 has been used as a reference for comparison. For JPEG images, the uncontrolled Fixed Quantisation mode (FIXEDQP mode) has been used as a reference as no standard technique of rate control was available.

The work on MPEG-2 video consists of three parts. In the first part, a modified version of the target bit rate $T_{pcr}$ computation proposed in TM5 has been presented. In TM5, for the computation of target bit rate for the current frame, the global complexity measure (GCM) of the previous frame (of corresponding type) has been used. In our technique, the GCM of the current frame is computed and used. Further $T_{pcr}$ is computed.
as a fraction of the available number of bits in the next $N_G$ frames rather than as a fraction of the available number of bits in the current group of pictures as is done in TM5 ($N_G$ refers to the number of frames in a group of pictures) The motivation for our modification is to reduce sharp changes in the MSE and SNR performances Simulation results have shown that the sharp changes in MSE and SNR have indeed been reduced

In the second part, a rate-quantisation model and its usage has been proposed A method for estimation of the model parameters for each frame using the data obtained in the GCM computation phase in the $T_{pcr}$ computation step is proposed This eliminates the need for a separate computation for their estimation The performance results of this model and its usage are presented

The third part, proposes a simple joint rate control technique for multiple video streams In this, the available total bit rate is distributed to various video streams based on their relative GCM Thus, the individual video streams are allowed to have variable bit rates while still keeping the total bit rate constant The technique was simulated for two streams and the SNR performance of the two streams were found to be more closer than they were when encoded separately

The work on rate control of JPEG images was motivated by the concepts used in video rate control Typical applications where rate control of images is required include, the remote sensing systems on satellites, aircrafts etc where image is generated onboard line by line and transmitted to ground after JPEG compression Two techniques have been proposed for such applications and their performance compared with uncontrolled FIXEDQP mode While one of the technique attempts to maintain a constant buffer depth, the other technique allows variation of buffer depth to maintain a constant quality Performance results have been presented