

ABSTRACT

The ever increasing demand for efficient storage and transmission of multimedia content consisting of both digital audio and video necessitates the development of efficient means for their compression. The need to embed multimedia applications in hand held devices such as mobile phones prohibits the use of recent video codecs like H.264 or H.265, which rely on motion compensated discrete cosine transform (DCT) based video coding, for this purpose. The work reported in this thesis adopts the alternate line of research in transform based video compression based on the application of the wavelet transform (WT) technique for compressing video data with a goal to reduce the complexity of the video codec.

First, a faster and fully scalable image codec is proposed based on the set partitioning in hierarchical trees (SPIHT) algorithm to encode the coefficients of an wavelet transformed image. The modifications include the use of a pre-processing step, use of the tree structure of the embedded zero tree wavelet (EZW) encoding algorithm in SPIHT and the use of edge enhancing decomposition (EED) for preserving the edge information at low bit rates. Further, a fully scalable image codec is developed by using the resolution scalable version of the SPIHT algorithm. The pre-processing step is then used along with 3D-SPIHT to design a two layer resolution scalable video codec. The designed video codec avoids the motion compensated temporal filtering (MCTF), used in contemporary 3D-DWT based video codecs, so as to reduce the complexity of the developed video codec.

Fast estimation of the rate-distortion (RD) performance is important for the efficient design of image/video codecs. The popular ρ -domain theory is suitably modified so that it could be used for rate estimation of the modified SPIHT based image codec. Further, the resulting distortion is modelled using the approximation theory. The estimation performance is close to the operational R-D behavior for still image compression. Finally, different rate allocation criteria are examined for assigning the bit rates to independent subband based coding units for designing a 3D-SPIHT based optimal video coder.

Keywords:

Discrete Wavelet Transform, Set Partitioning in Hierarchical Trees, Zero-Shifting, Edge Enhanced Decomposition, Wavelet Packet Decomposition, Resolution Scalability, Rate-Distortion Analysis.