Region-Based Video Coding with Embedded Zero-Trees

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In this paper, we describe a region-based video coding algorithm that is currently under investigation for inclusion in the emerging MPEG4 standard. This algorithm was incorporated in a submission that scored highly in the MPEG4 subjective tests of November 1995. Good coding efficiency is achieved by combining motion segmented region-based coding with the Shapiro's embedded zero-tree wavelet (EZW) method. Because motion compensation typically concentrates residual energy in specific regions, we gain coding efficiency using region-based coding instead of full-frame wavelet techniques. The motion estimation/compensation used is the same as the MPEG4 verification model: essentially H.263 with unrestricted motion vector and advanced prediction modes. A segmentation mask is generated from the resulting residual image. Morphological operations are used in the segmentation to identify large connected areas and eliminate isolated small regions, thereby increasing the efficiency of the subsequent zero-tree algorithm. Then the texture information inside the segmentation mask is coded using an embedded zero-tree algorithm adapted to accommodate the segmentation. The segmentation mask is combined with the motion vector modes for efficient coding. This work is based on a region-based video codec developed by Oehler. The differences are: (1) segmentation uses morphological operations, (2) Intra macroblocks for P frames are introduced to better code scene changes, (3) the wavelet codec is developed and evaluated within the framework of MPEG4 verification model.

The simulation results show that both the wavelet codec and the DCT-based codec have similar PSNRs. The subjective quality of the wavelet codec is better for most sequences. The wavelet codec offers additional functionality such as scalability and error resilience. A full exposition of this paper is available by sending email to the first author.