An Enhanced Robust Entropy Coder for Video Codecs Based on Context-Adaptive Reversible VLC

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Reversible variable length coding (RVLC) is an important robust entropy coding technique for error resilient video transmission. The popular DCT-based video codecs all can use it. RVLC supports both the forward and backward decoding, so that the error-free data in the backward direction can be recovered. But RVLC can not retrieve the intact data between separate errors. This will degrade its error resilience performance especially in high error rates. On the other hand, as context modeling is widely adopted in modern entropy coders, RVLC shows low coding efficiency. Therefore, our design aims to improve the traditional RVLC in both error resilience and coding efficiency.

An enhanced RVLC coder, Context-adaptive Reversible VLC (CRVLC), is proposed for DCT coefficients by using the techniques of data sub-partitioning and context modeling. The data sub-partitioning means that the data part of DCT coefficients is split into several small sub-partitions. As each sub-partition can be reversibly decoded by RVLC, more data as well as higher error resilience can be obtained. The context modeling exploits the correlation of DCT coefficients for further compression. This modeling defines the contexts by hierarchical-dependent information. The information is also available in the backward decoding, so that it supports the reversible decoding. And with it the data outputted by CRVLC can be naturally placed into multiple sub-partitions.

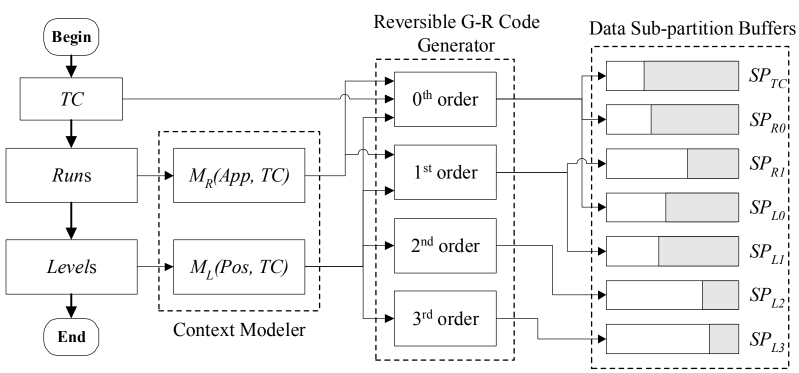

Fig. 1. Coding procedures of CRVLC.

CRVLC encodes a DCT block as figure 1 shows. Before the coding a DCT block is zig-zag scanned to form the *Runs*, the run-length of zero coefficients, and the *Levels*, the nonzero coefficients. The number of the nonzero coefficients, *TC*, is firstly coded. Then the *Runs* are adaptively coded under the contexts of $M_R(App, TC)$, where *App* means the appearance order of a *Run*. M_R defines under the pair of *App* and *TC* of a specific *Run* which order of Reversible Golomb-Rice (R-GR) codes is used to encode it. Given the *Runs*, each *Level*'s position (*Pos*) in a block is known. At last, the *Levels* are adaptively coded with the contexts of $M_L(Pos, TC)$. The coded data are placed into the sub-partitions like SP_{TC} and SP_{R0} according to the data category and the R-GR codes' order.

Our experimental results show that CRVLC can gain about 0.5dB at high bit-rates for coding efficiency and up to 2.5dB for error resilience at different bit error rates, compared with the traditional RVLC and on tested videos.

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