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Question: Q.6/SG16 (VCEG)
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Title: VLC concatenation for Intra coding
Purpose: Proposal

1. Background

In document Q15K30 Gisle Bjontegaard showed that intra coding improvements are possible by switching between two VLC tables. A drawback of the method, however, was that it departed from the universal-VLC approach of H.26L. This document presents a way to construct a new VLC that solves this problem, as the new VLC can be viewed as a different interpretation of an original H.26L stream.

2. The new VLC

The new VLC is constructed by using the shortest original UVLC codeword "1" as an optional prefix to the rest of the words. In order to be able to distinguish all codewords from each other, the new index 0 codeword must have a prefix. The new codewords are called UVLC2 in this document. See Table 1 for a comparison between UVLC and UVLC2.

Table 1. The first nine codewords of UVLC and UVLC2

Index	UVLC	UVLC2
0	1	11
1	001	001
2	011	011
3	00001	1001
4	00011	1011
5	01001	00001
6	01011	00011
7	0000001	01001
8	0000011	01011

By using UVLC2 when coding a symbol you lose one bit for index 0, whereas for all other indices you either save up to two bits or get the same performance.

3. Resynchronizing property of the new VLC

Since the new codewords are just concatenations of old codewords, UVLC2 keeps much of the resynchronizing properties of UVLC. The only issue is whether biterrors can cause the prefixes to come out of sync. However, it is easy to see that codewords with index > 0 resynchronizes the bitstream within two codewords.

4. Switching between UVLC and UVLC2

The switching applies to Intra luma coefficients in double scan with the following rules:

- First coefficient, first scan: use UVLC2 if the above or left block is unavailable or if $\text{abs}(\text{dc_above}) + \text{abs}(\text{dc_left}) > 2$, where $\text{dc}=1$ is used outside the present macroblock.
- First coefficient, second scan: use UVLC2 if $\text{abs}(\text{dc}) > 2$ or if first scan had >3 coefficients.
- Second coefficients: use UVLC2 if $\text{abs}(\text{previous_level}) > 2(1)$ for first (second) scan.
- Third through sixth coefficients: use UVLC2 if $\text{abs}(\text{previous_level})/(\text{previous_run}+2) > 0$.

5. Coding improvements

The coding improvements are reported in the included Excel sheet, where quantizers 10, 13, 16, 19, 22 and 25 have been used. The bit reduction figures were computed for each rate-distortion point of the old TML curves by comparing with the linearly interpolated bit usage of the new curves at the same PSNR values.

It is also possible to construct another set of codewords, UVLC3, consisting of original UVLC codewords with zero, one or two prefixes. By switching between UVLC, UVLC2 and UVLC3 even higher gains can be achieved. The corresponding figures are included in the chart as information.



Microsoft Excel
Worksheet