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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  19th Meeting: Strasbourg, FR, 17–24 Oct. 2014 | Document: JCTVC-S0174 |

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| *Title:* | **CE6: Test C.3 Copy previous row mode for palette coding** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Feng Zou Wei Pu Marta Karczewicz Rajan Joshi Vadim Seregin  Sole Joel  5775 Morehouse Drive San Diego, CA, 92122 | Tel: Email: | +1-858-845-1115 [fzou@qti.qualcomm.com](mailto:fzou@qti.qualcomm.com) [wpu@qti.qualcomm.com](mailto:wpu@qti.qualcomm.com) |
| *Source:* | Qualcomm Incorporated | | |

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# Abstract

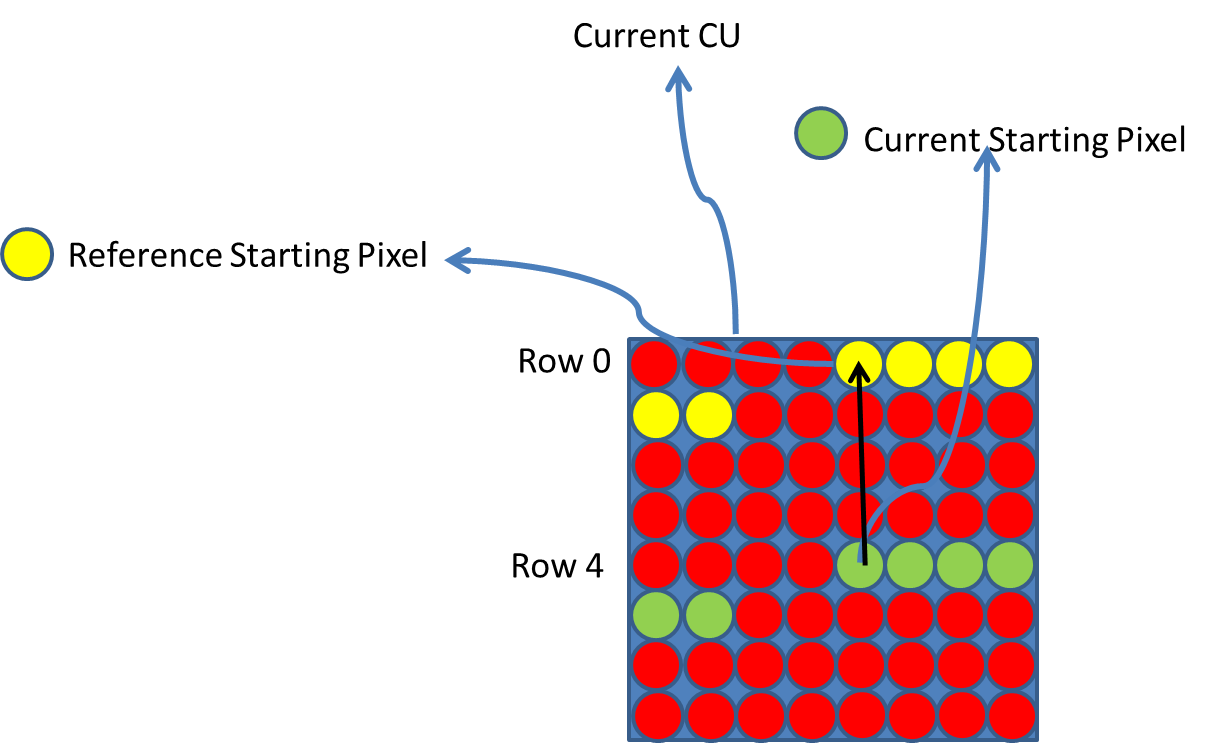
This proposal presents a “copy previous row” mode for the palette coding. The proposed method enables to copy pixels from previously coded rows beyond the row above. This is defined as a palette mode besides the existing “Copy left”, “Copy above” and “Escape” modes. The reference row index is coded in the bitstream to indicate which row is copied from. The simulation results report that the proposed method achieves 1.2% and 1.4% BD-rate savings for 1080p text and graphics RGB and YUV respectively against the SCM2.0 anchor in the full frame intra BC test condition. When the ‘Copy above’ and ‘Copy previous row” are enabled for the first row and the second row, the proposed method achieves 1.5% and 1.7% BD-rate reduction in the same test condition.

# Introduction

In the 18th JCT-VC meeting in Sapporo, CE6 [1] was established to study different palette representation methods. JCTVC-R0202 [2] proposed the copy from previous row mode for palette coding and is being studied in CE6 Test C.3 to improve the coding efficiency of palette coding.

# Proposed copy previous row mode for palette coding

To achieve a better coding efficiency, it is proposed that all the previous coded rows in the current block are available as reference, and this mode is called “Copy previous row” mode. The proposed mode is added in the available palette mode candidate list. The row offset information is coded when the current string chooses “Copy previous row” mode using truncated binary codeword. Basically, a shorter codeword is designed for the row which is near the current row. Like with other modes, the run length is coded in the bitstream. An illustration of the proposed mode is shown in Fig. 1.



**Fig. 1. ‘Copy previous row’ with Row 0 as the reference**

To reduce the encoder complexity, the proposed mode is enabled only when the palette size is larger than 2 for the current CU. To reduce the redundancy with “Copy from above”, the reference rows exclude the above row, and therefore, the proposed “Copy previous row” mode is valid starting from the third row of the current CU. And if the last coded neighboring pixel uses “Copy previous row” mode with reference row offset ***T***, the reference row offset cannot be equal to ***T***. Therefore, one reference row offset is removed from the reference row list during row offset coding. Run constraint (minimum run length equal to 3) is also applied to “copy previous row” mode since the run is usually longer than the other two modes. At the encoder, the three modes are chosen based on averaged bits per pixel and the results for encoder only change is in JCTVC-S0156. And the simulation results can be found in Configuration 1.

Note that “copy previous row” mode is enabled starting from the third row in the current CU. It is further proposed to enable this mode and “copy above” mode starting from the first row by padding index 0 for “-1” and “-2” rows, where “-1” row represents the row above the first row, and “-2” row represents the row two rows above the first row. And the simulation can be found in Configuration 2.

# Simulation results

The proposed scheme is implemented on SCC common software and tested using the common test condition defined in [3]. Table 1 demonstrates the coding performance with the proposed ‘copy previous row” mode. And Table 2 demonstrate the coding performance under full frame Intra BC test conditions with the proposed “copy previous row” mode and padding for “-1” and “-2” rows.

Table 1: Configuration 1: copy previous row mode

|  |  |  |  |
| --- | --- | --- | --- |
|  | **All Intra** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p | -1.2% | -1.4% | -1.4% |
| RGB, text & graphics with motion,720p | -0.6% | -0.7% | -0.7% |
| RGB, mixed content, 1440p | -0.1% | -0.2% | -0.2% |
| RGB, mixed content, 1080p | -1.2% | -1.6% | -1.3% |
| RGB, Animation, 720p | 0.0% | 0.0% | 0.0% |
| RGB, camera captured, 1080p | 0.0% | 0.0% | 0.0% |
| YUV, text & graphics with motion, 1080p | -1.4% | -1.5% | -1.5% |
| YUV, text & graphics with motion,720p | -0.5% | -0.7% | -1.0% |
| YUV, mixed content, 1440p | -0.3% | -0.7% | -0.6% |
| YUV, mixed content, 1080p | -1.2% | -3.3% | -2.7% |
| YUV, Animation, 720p | 0.0% | -0.1% | -0.1% |
| YUV, camera captured, 1080p | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 103% | | |
| Dec Time[%] | 100% | | |
|  |  |  |  |
|  | **Random Access** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p | -0.6% | -0.7% | -0.7% |
| RGB, text & graphics with motion,720p | -0.5% | -0.6% | -0.6% |
| RGB, mixed content, 1440p | -0.1% | -0.3% | -0.2% |
| RGB, mixed content, 1080p | -0.8% | -1.3% | -1.1% |
| RGB, Animation, 720p | 0.0% | 0.0% | -0.1% |
| RGB, camera captured, 1080p | 0.0% | 0.0% | 0.0% |
| YUV, text & graphics with motion, 1080p | -0.7% | -0.9% | -0.9% |
| YUV, text & graphics with motion,720p | -0.5% | -0.7% | -1.0% |
| YUV, mixed content, 1440p | -0.2% | -0.8% | -0.2% |
| YUV, mixed content, 1080p | -1.0% | -3.2% | -2.4% |
| YUV, Animation, 720p | 0.0% | 0.0% | 0.0% |
| YUV, camera captured, 1080p | 0.0% | 0.1% | 0.0% |
| Enc Time[%] | 101% | | |
| Dec Time[%] | 99% | | |
|  |  |  |  |
|  | **Low delay B** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p | -0.5% | -0.6% | -0.6% |
| RGB, text & graphics with motion,720p | -0.5% | -0.5% | -0.5% |
| RGB, mixed content, 1440p | -0.1% | -0.4% | -0.3% |
| RGB, mixed content, 1080p | -1.0% | -1.1% | -0.3% |
| RGB, Animation, 720p | 0.0% | 0.1% | 0.0% |
| RGB, camera captured, 1080p | 0.0% | 0.0% | 0.0% |
| YUV, text & graphics with motion, 1080p | -0.5% | -0.8% | -0.7% |
| YUV, text & graphics with motion,720p | -0.5% | -0.7% | -0.8% |
| YUV, mixed content, 1440p | -0.4% | -1.0% | -0.8% |
| YUV, mixed content, 1080p | -1.2% | -3.3% | -2.7% |
| YUV, Animation, 720p | 0.1% | -0.2% | 0.3% |
| YUV, camera captured, 1080p | 0.0% | -0.1% | 0.0% |
| Enc Time[%] | 101% | | |
| Dec Time[%] | 98% | | |

Table 2: Configuration 2: copy previous row + padding for -1/-2 rows

|  |  |  |  |
| --- | --- | --- | --- |
|  | **All Intra** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p | -1.5% | -1.6% | -1.6% |
| RGB, text & graphics with motion,720p | -0.8% | -0.9% | -0.8% |
| RGB, mixed content, 1440p | -0.2% | -0.2% | -0.2% |
| RGB, mixed content, 1080p | -1.2% | -1.6% | -1.3% |
| RGB, Animation, 720p | 0.0% | 0.0% | 0.0% |
| RGB, camera captured, 1080p | 0.0% | 0.0% | 0.0% |
| YUV, text & graphics with motion, 1080p | -1.7% | -1.8% | -1.8% |
| YUV, text & graphics with motion,720p | -0.7% | -0.9% | -1.0% |
| YUV, mixed content, 1440p | -0.3% | -0.8% | -0.7% |
| YUV, mixed content, 1080p | -1.2% | -3.3% | -2.7% |
| YUV, Animation, 720p | 0.0% | 0.0% | 0.0% |
| YUV, camera captured, 1080p | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 103% | | |
| Dec Time[%] | 99% | | |
|  |  |  |  |
|  | **Random Access** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p | -0.8% | -0.8% | -0.8% |
| RGB, text & graphics with motion,720p | -0.6% | -0.7% | -0.7% |
| RGB, mixed content, 1440p | -0.2% | -0.2% | -0.3% |
| RGB, mixed content, 1080p | -0.8% | -1.2% | -1.1% |
| RGB, Animation, 720p | 0.0% | 0.0% | -0.1% |
| RGB, camera captured, 1080p | 0.0% | 0.0% | 0.0% |
| YUV, text & graphics with motion, 1080p | -0.8% | -1.1% | -1.1% |
| YUV, text & graphics with motion,720p | -0.6% | -0.8% | -1.2% |
| YUV, mixed content, 1440p | -0.3% | -0.8% | -0.5% |
| YUV, mixed content, 1080p | -1.0% | -3.1% | -2.6% |
| YUV, Animation, 720p | 0.1% | -0.3% | -0.1% |
| YUV, camera captured, 1080p | 0.0% | 0.1% | -0.1% |
| Enc Time[%] | 101% | | |
| Dec Time[%] | 99% | | |
|  |  |  |  |
|  | **Low delay B** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p | -0.6% | -0.7% | -0.7% |
| RGB, text & graphics with motion,720p | -0.5% | -0.5% | -0.7% |
| RGB, mixed content, 1440p | -0.2% | -0.4% | -0.3% |
| RGB, mixed content, 1080p | -0.7% | -1.0% | -0.8% |
| RGB, Animation, 720p | 0.0% | 0.1% | 0.1% |
| RGB, camera captured, 1080p | 0.0% | 0.0% | 0.0% |
| YUV, text & graphics with motion, 1080p | -0.6% | -1.0% | -0.9% |
| YUV, text & graphics with motion,720p | -0.6% | -0.7% | -1.2% |
| YUV, mixed content, 1440p | -0.3% | -1.4% | -1.0% |
| YUV, mixed content, 1080p | -1.4% | -3.9% | -2.8% |
| YUV, Animation, 720p | 0.1% | -0.2% | 0.2% |
| YUV, camera captured, 1080p | 0.0% | -0.1% | 0.0% |
| Enc Time[%] | 101% | | |
| Dec Time[%] | 98% | | |

# Conclusions

This proposal presents a “copy previous row” mode for the palette coding. The proposed method enables to copy pixels from previously coded rows beyond the row above. The proposed method results in 1.2% and 1.4% BD-rate savings for 1080p text and graphics RGB and YUV respectively against the SCM2.0 anchor in the SCC common test condition. When the copy above and copy previous row are enabled for the first row, the proposed method achieves 1.5% and 1.7% BD-rate reduction in the same test condition. It is recommended to be included in the spec and reference software of SCC.

# Patent rights declaration(s)

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# References

1. Y. Huang, P. Onno, R. Cohen, V. Seregin, X. Xiu, and Z. Ma, “Description of Core Experiment 6 (CE6): Improvements of palette mode,” JCTVC-R1106.
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