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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**  8th Meeting: San José, CA, USA, 1–10 February, 2012 | Document: JCTVC-H0677 |

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| *Title:* | **Non-CE11: Crosscheck for Intel's Coefficient Sub-sampling for Large Transform in JCTVC-H0249** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Information | | |
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# Abstract

This contribution is a cross-verification of Intel’s coefficient sub-sampling for large transform proposed in document JCTVC-H0249. The cross-verification has been done successfully on Linux computer farm in terms of BD-rates, subjective evaluation and code reviewing. It is reported that the BD-rates match those provided by Intel perfectly. The visual quality is reported to be similar to HM5.0.

# Objective Evaluation

The simulation has been done based on all the configurations of common test condition in JCTVC-G1200 [1]. The figures in Table 1 confirm the results and running time issues in Intel’s proposal [2] for mandatory test configurations. The figures in Table 2 confirm the results and running time issues in Intel’s proposal [2] for full test configurations.

Table 1. Objective Results of mandatory test configurations by Mediatek

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra HE** | | | **All Intra LC** | | | **All Intra HE-10** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A (8bit) | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% |  |  |  |
| Class B | 0.1% | 0.1% | 0.1% | 0.1% | -0.3% | -0.3% |  |  |  |
| Class C | 0.2% | 0.4% | 0.2% | 0.1% | 0.4% | 0.3% |  |  |  |
| Class D | 0.1% | 0.2% | 0.1% | 0.1% | 0.2% | 0.1% |  |  |  |
| Class E | 0.1% | 0.0% | 0.0% | 0.0% | -0.1% | -0.1% |  |  |  |
| **Overall** | 0.1% | 0.2% | 0.1% | 0.1% | 0.0% | 0.0% |  |  |  |
|  | 0.1% | 0.2% | 0.1% | 0.1% | 0.0% | 0.0% |  |  |  |
| Class F | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% | 0.1% |  |  |  |
| Enc Time[%] | 100% | | | 100% | | |  | | |
| Dec Time[%] | 100% | | | 99% | | |  | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **Random Access HE** | | | **Random Access LC** | | | **Random Access HE-10** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A (8bit) | 0.0% | 0.1% | -0.1% | 0.0% | 0.1% | 0.1% | 0.0% | 0.1% | 0.0% |
| Class B | 0.1% | 0.0% | 0.2% | 0.0% | 0.1% | 0.4% | 0.2% | 0.1% | 0.0% |
| Class C | 0.2% | 0.1% | 0.0% | 0.1% | 0.2% | 0.2% |  |  |  |
| Class D | 0.1% | -0.2% | -0.1% | 0.0% | 0.0% | -0.2% |  |  |  |
| Class E |  |  |  |  |  |  |  |  |  |
| **Overall** | 0.1% | 0.0% | 0.1% | 0.0% | 0.1% | 0.1% | 0.1% | 0.1% | 0.0% |
|  | 0.1% | 0.0% | 0.1% | 0.0% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% |
| Class F | 0.0% | 0.0% | -0.1% | 0.1% | 0.1% | 0.2% |  |  |  |
| Enc Time[%] | 100% | | | 100% | | | 100% | | |
| Dec Time[%] | 100% | | | 100% | | | 96% | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **Low delay B HE** | | | **Low delay B LC** | | | **Low delay B HE-10** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A |  |  |  |  |  |  |  |  |  |
| Class B | 0.1% | -0.1% | 0.0% | 0.0% | 0.0% | 0.8% |  |  |  |
| Class C | 0.2% | -0.1% | -0.1% | 0.2% | 0.0% | 0.1% |  |  |  |
| Class D | 0.0% | -0.3% | -0.1% | 0.0% | 0.7% | 0.4% |  |  |  |
| Class E | 0.1% | 0.6% | -0.3% | 0.0% | -1.0% | 0.3% |  |  |  |
| **Overall** | 0.1% | 0.0% | -0.1% | 0.1% | 0.0% | 0.4% |  |  |  |
|  | 0.1% | 0.0% | -0.1% | 0.1% | 0.1% | 0.4% |  |  |  |
| Class F | 0.0% | -0.1% | 0.0% | 0.3% | 0.1% | -0.4% |  |  |  |
| Enc Time[%] | 99% | | | 99% | | |  | | |
| Dec Time[%] | 95% | | | 99% | | |  | | |

Table 2. Objective Results of full test configurations by Mediatek

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra HE** | | | **All Intra LC** | | | **All Intra HE-10** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | 0.0% | 0.0% | 0.1% | 0.0% | -0.1% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class B | 0.1% | 0.1% | 0.1% | 0.1% | -0.3% | -0.3% | 0.1% | 0.1% | 0.1% |
| Class C | 0.2% | 0.4% | 0.2% | 0.1% | 0.4% | 0.3% | 0.2% | 0.4% | 0.2% |
| Class D | 0.1% | 0.2% | 0.1% | 0.1% | 0.2% | 0.1% | 0.1% | 0.2% | 0.1% |
| Class E | 0.1% | 0.0% | 0.0% | 0.0% | -0.1% | -0.1% | 0.1% | 0.0% | 0.0% |
| Class F | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% | 0.1% |
| **Overall** | 0.1% | 0.1% | 0.1% | 0.1% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% |
|  | 0.1% | 0.2% | 0.1% | 0.1% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% |
| Enc Time[%] | 100% | | | 100% | | | 100% | | |
| Dec Time[%] | 100% | | | 99% | | | 100% | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **Random Access HE** | | | **Random Access LC** | | | **Random Access HE-10** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | 0.0% | 0.1% | -0.2% | 0.0% | 0.0% | 0.1% | 0.0% | 0.1% | 0.0% |
| Class B | 0.1% | 0.0% | 0.2% | 0.0% | 0.1% | 0.4% | 0.2% | 0.1% | 0.0% |
| Class C | 0.2% | 0.1% | 0.0% | 0.1% | 0.2% | 0.2% | 0.2% | 0.1% | 0.0% |
| Class D | 0.1% | -0.2% | -0.1% | 0.0% | 0.0% | -0.2% | 0.1% | 0.0% | 0.2% |
| Class E |  |  |  |  |  |  |  |  |  |
| Class F | 0.0% | 0.0% | -0.1% | 0.1% | 0.1% | 0.2% | 0.2% | 0.1% | 0.2% |
| **Overall** | 0.1% | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% |
|  | 0.1% | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% |
| Enc Time[%] | 100% | | | 100% | | | 98% | | |
| Dec Time[%] | 100% | | | 100% | | | 96% | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **Low delay B HE** | | | **Low delay B LC** | | | **Low delay B HE-10** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A |  |  |  |  |  |  |  |  |  |
| Class B | 0.1% | -0.1% | 0.0% | 0.0% | 0.0% | 0.8% | 0.1% | -0.4% | -0.1% |
| Class C | 0.2% | -0.1% | -0.1% | 0.2% | 0.0% | 0.1% | 0.2% | -0.1% | -0.2% |
| Class D | 0.0% | -0.3% | -0.1% | 0.0% | 0.7% | 0.4% | 0.0% | 0.1% | 0.4% |
| Class E | 0.1% | 0.6% | -0.3% | 0.0% | -1.0% | 0.3% | -0.1% | -1.1% | 0.0% |
| Class F | 0.0% | -0.1% | 0.0% | 0.3% | 0.1% | -0.4% | 0.2% | 0.3% | 0.1% |
| **Overall** | 0.1% | -0.1% | -0.1% | 0.1% | 0.0% | 0.2% | 0.1% | -0.2% | 0.0% |
|  | 0.1% | -0.1% | -0.1% | 0.1% | 0.1% | 0.2% | 0.1% | -0.2% | 0.0% |
| Enc Time[%] | 99% | | | 99% | | | 96% | | |
| Dec Time[%] | 95% | | | 99% | | | 96% | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **Low delay P HE** | | | **Low delay P LC** | | | **Low delay P HE-10** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A |  |  |  |  |  |  |  |  |  |
| Class B | 0.0% | 0.0% | -0.2% | -0.1% | 0.2% | 0.0% | 0.0% | -0.3% | -0.2% |
| Class C | 0.2% | 0.1% | -0.3% | 0.2% | 0.0% | 0.3% | 0.2% | -0.1% | -0.2% |
| Class D | 0.0% | 0.2% | -0.3% | -0.1% | 0.3% | 0.7% | 0.1% | -0.6% | 0.2% |
| Class E | 0.0% | 0.0% | 0.4% | 0.0% | -1.7% | -0.7% | -0.2% | -1.0% | -0.6% |
| Class F | 0.1% | 0.2% | 0.2% | 0.4% | -0.1% | 0.4% | 0.0% | 0.1% | 0.2% |
| **Overall** | 0.1% | 0.1% | -0.1% | 0.1% | -0.2% | 0.2% | 0.0% | -0.3% | -0.1% |
|  | 0.1% | 0.1% | -0.1% | 0.1% | -0.2% | 0.2% | 0.1% | -0.3% | -0.1% |
| Enc Time[%] | 98% | | | 99% | | | 96% | | |
| Dec Time[%] | 95% | | | 99% | | | 96% | | |

# Subjective Evaluation

An informal subjective evaluation shows no obvious performance difference between the proposal and HM5.0.

# Source Code Investigation

In Intel’s scheme, half sub-sampling (HSS) is applied to 32x32 transform and quarter sub-sampling (QSS) is applied to 16x16 transform. In total, six macros are defined in the source code:

1. **COEFF\_SUBSAMPLING**:

This macro is used to activate the proposed scheme.

1. **COEFF\_SUBSAMPLE\_MASK**:

This macro is used to determine which coefficients to drop. The value 0 indicates even position sub-sampling whereas the value 1 indicates odd position sub-sampling.

1. **COEFF\_SUBSAMPLE\_32**:

This macro is used to enable sub-sampling for 32x32 transform.

1. **COEFF\_SUBSAMPLE\_BAND\_32**:

This macro is used to determine the HSS range for 32x32 transform. The default range is N/2 to N-1.

1. **COEFF\_SUBSAMPLE\_16**:

This macro is used to enable sub-sampling for 16x16 transform.

1. **COEFF\_SUBSAMPLE\_BAND\_16**:

This macro is used to determine the QSS range for 16x16 transform. The default range is 3N/4 to N-1.

# Conclusion

The software and experimental results of Intel’s contribution JCTVC-H0249 were cross-verified. The results provided by Intel are confirmed.

# References

1. F. Bossen, “Common HM test conditions and software reference configurations,” JCTVC-G1200, JCT-VC meeting, Geneva, CH, Nov. 2011.
2. Y. Chiu, W. Zhang, L. Xu and Y. Han, “Non-CE11: Coefficient sub-sampling for large transform,” JCTVC-H0249, JCT-VC meeting, San José, USA, Feb. 2012.