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| *Title:* | **CE1: Cross-check of mode-dependent transform simplifications** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution reports the results of a cross-check performed for two simplifications of mode-dependent transform proposed in JCTVC-I0582. The proposed methods were reportedly independently implemented, and the compression results matched those provided by the proponents. In addition, results for the complete removal of 4-point DCT are also provided.

# Introduction

In JCTVC-H0582, two simplifications for mode-dependent transform of intra 4x4 luma TUs were proposed. In the first simplification, the DST is used in both horizontal and vertical directions for all intra 4x4 luma TUs, regardless of the intra prediction mode. In the second simplification, the DCT is used in both horizontal and vertical directions for 4x4 luma TUs with DC intra prediction mode, while the DST is used in both directions for 4x4 luma TUs in the remaining modes.

In addition, for reference, we tested a third simplification where the DST is used for all 4x4 TUs, for both luma and chroma components, and for both Intra and Inter coded blocks. In this case, the 4-point DCT is no longer needed and can be removed.

# Simulation results

We have independently implemented the first two simplifications and tested them in common conditions for All-Intra main and All-Intra HE10. We also implemented the third simplification and tested it in common conditions for all combinations of (All-Intra, Random Access, Low-Delay B) and (Main, HE10).

**Simplification 1:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main** | | | **All Intra HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | -0.1% | -0.1% | -0.2% | -0.1% | -0.2% | -0.1% |
| Class B | 0.0% | -0.2% | -0.2% | 0.0% | -0.1% | -0.2% |
| Class C | 0.2% | -0.2% | -0.2% | 0.2% | -0.1% | -0.2% |
| Class D | 0.2% | -0.1% | -0.2% | 0.2% | -0.1% | -0.1% |
| Class E | 0.0% | -0.2% | -0.2% | 0.0% | -0.2% | -0.2% |
| **Overall** | 0.1% | -0.2% | -0.2% | 0.1% | -0.1% | -0.2% |
|  | 0.1% | -0.2% | -0.2% | 0.1% | -0.1% | -0.1% |
| Class F | 0.5% | 0.1% | 0.1% | 0.4% | 0.0% | 0.3% |
| Enc Time[%] | 100% | | | 101% | | |
| Dec Time[%] | 100% | | | 101% | | |

**Simplification 2:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main** | | | **All Intra HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | -0.1% | -0.1% | -0.1% | -0.1% | -0.1% | -0.1% |
| Class B | 0.0% | -0.1% | -0.1% | 0.0% | -0.1% | -0.1% |
| Class C | 0.1% | -0.1% | -0.1% | 0.1% | -0.1% | -0.1% |
| Class D | 0.1% | 0.0% | -0.1% | 0.1% | -0.1% | -0.1% |
| Class E | 0.0% | -0.1% | -0.2% | 0.0% | -0.1% | -0.1% |
| **Overall** | 0.0% | -0.1% | -0.1% | 0.0% | -0.1% | -0.1% |
|  | 0.0% | -0.1% | -0.1% | 0.0% | -0.1% | -0.1% |
| Class F | 0.3% | 0.1% | 0.1% | 0.2% | 0.0% | 0.1% |
| Enc Time[%] | 100% | | | 100% | | |
| Dec Time[%] | 100% | | | 100% | | |

**Simplification 3:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main** | | | **All Intra HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | -0.1% | 0.8% | 0.9% | -0.1% | 0.8% | 1.0% |
| Class B | 0.0% | 1.2% | 1.3% | 0.0% | 1.6% | 1.8% |
| Class C | -0.1% | 1.0% | 1.1% | -0.1% | 1.8% | 2.4% |
| Class D | 0.0% | 1.3% | 1.3% | -0.1% | 2.3% | 2.7% |
| Class E | -0.2% | 2.0% | 0.9% | -0.2% | 3.3% | 2.7% |
| **Overall** | -0.1% | 1.2% | 1.1% | -0.1% | 1.9% | 2.1% |
|  | -0.1% | 1.2% | 1.1% | -0.1% | 1.8% | 2.0% |
| Class F | 0.3% | 1.2% | 1.0% | 0.3% | 1.5% | 1.5% |
| Enc Time[%] | 99% | | | 99% | | |
| Dec Time[%] | 100% | | | 100% | | |
|  |  |  |  |  |  |  |
|  | **Random Access Main** | | | **Random Access HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | 0.0% | 0.6% | 1.0% | 0.1% | 1.1% | 0.9% |
| Class B | 0.0% | 1.9% | 1.8% | 0.1% | 1.9% | 2.0% |
| Class C | 0.1% | 1.3% | 1.6% | 0.1% | 1.7% | 1.9% |
| Class D | 0.2% | 1.9% | 2.0% | 0.1% | 1.7% | 2.2% |
| Class E |  |  |  |  |  |  |
| **Overall** | 0.1% | 1.4% | 1.6% | 0.1% | 1.6% | 1.8% |
|  | 0.1% | 1.4% | 1.5% | 0.1% | 1.6% | 1.8% |
| Class F | 0.5% | 1.2% | 0.7% | 0.4% | 1.9% | 1.7% |
| Enc Time[%] | 100% | | | 100% | | |
| Dec Time[%] | 100% | | | 99% | | |
|  |  |  |  |  |  |  |
|  | **Low delay B Main** | | | **Low delay B HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A |  |  |  |  |  |  |
| Class B | -0.1% | 1.3% | 1.4% | 0.0% | 1.1% | 1.1% |
| Class C | 0.0% | 0.8% | 1.0% | 0.0% | 1.0% | 1.5% |
| Class D | 0.1% | 1.7% | 1.9% | 0.1% | 2.5% | 1.3% |
| Class E | -0.1% | 2.9% | 0.9% | 0.0% | 3.3% | 1.9% |
| **Overall** | 0.0% | 1.6% | 1.3% | 0.0% | 1.8% | 1.4% |
|  | 0.0% | 1.5% | 1.2% | 0.0% | 1.9% | 1.4% |
| Class F | 0.3% | 1.0% | 1.0% | 0.7% | 1.7% | 1.9% |
| Enc Time[%] | 100% | | | 100% | | |
| Dec Time[%] | 101% | | | 99% | | |

# Conclusions

We have performed an independent cross-check of the two simplifications proposed in JCTVC-H0582. In addition, we also provided additional results for the case where the only 4-point transform is the DST.

# Patent rights declaration(s)

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