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| *Title:* | **Restricting CU Depth in Enhancement Layer for SHVC** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution proposes an algorithm that restricts CU depth to reduce encoding complexity of enhancement layer (EL) for Scalable HEVC (SHVC). The proposed method reduces the encoding time of CU-level rate distortion optimization (RDO) process in EL encoder by restricting candidates of CU depth in EL according to the CU depth of the collocated CU in the base layer (BL). Compared to SMuC-0.1.1 software, average encoding time of the proposed algorithm decreases by 23.3% for 2x spatial scalability case, 26.7% for 1.5x spatial scalability case, and 19.8% for SNR scalability case. Note that average BD-rate performance decreases by 0.58% for 2x spatial scalability, 0.65% for 1.5x spatial scalability, and 1.0% for SNR scalability.

# Introduction

The restricting CU depth for enhancement layer (EL) is presented to reduce the encoding complexity of EL in Scalable HEVC (SHVC). Although the current version of SHVC includes only intraBL, further coding tools are planned to be added to SHVC. To support real-time application using SHVC, it is necessary to reduce computational complexity of SHVC which is expected to be high due to its multi-layer structure and complex inter-layer coding tools. In addition, extensive evaluations for SHVC standardization can be done in limited given time with the fast encoding algorithm. To reduce time complexity of SHVC encoder, RDO process is simplified by restricting CU depth level for EL with similarity between CU depths of base layer (BL) and EL.

# Proposed algorithm

For EL, target-depth *Dt* is defined with the depth of the collocated CU in BL and a ratio (*R*) between the spatial resolutions of BL and EL, as follows:

(1)

where *DBL* is the depth of the collocated CU in BL. Figure 1 depicts a CU in EL and the collocated CU in BL in 2x spatial scalability. The target-depth of the three CUs labeled “A” in EL is given by 2 by Eq. (1) since the depth of the collocated CU in the BL is 2 and the *R* is 2, and the other CU labeled “B” has the target-depth of 3 as the collocated CU in BL has depth of 3. In the proposed algorithm, the candidates for a CU depth in EL are set to the target-depth and target-depth±1 for slice types of P and B. Therefore, the depth candidates of CU in EL are {1, 2, 3} for “A” CUs and {2, 3, 4} for “B” CU.

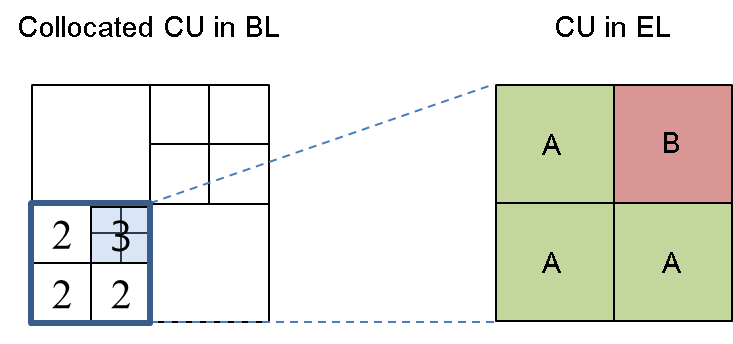


Figure 1. A CU in EL and the collocated CU in BL in 2x spatial scalability

In case of I-slice, we do not apply the proposed algorithm since it is observed that simplification CU depth candidates in EL for I-slice result in significant increment in BD-rate. It is assumed that such observation is due to the fact that intra slices are in general used as reference frames whose degradation could result in propagation of coding loss.

# Performance

All the experimentations were carried out in the same conditions as defined in TEs.

## Spatial scalability

Table 1 and Table 2 show performance of the proposed algorithm in terms of BD-rate and encoding time for s spatial scalability. Average encoding time decreases by 23.3% and average BD-rate increases by 0.6% in 2x spatial scalability. In case of 1.5x spatial scalability, average encoding time decreases by 26.7% average BD-rate increases by 0.65%.

Table 1. Performance of the proposed algorithm for 2x spatial scalability (BL+EL)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **RA HEVC 2x** | | | **LD-P HEVC 2x** | | |
| Y | U | V | Y | U | V |
| Class A | 0.5% | 0.7% | 0.6% | 0.5% | 1.1% | 1.0% |
| Class B | 0.5% | 0.6% | 0.6% | 0.7% | 0.7% | 0.6% |
| **Overall** | **0.5%** | **0.6%** | **0.6%** | **0.7%** | **0.8%** | **0.7%** |
| Enc Time (EL/BL) | **77.1%** | | | **76.3%** | | |

Table 2. Performance of the proposed algorithm for 1.5x spatial scalability (BL+EL)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **RA HEVC 1.5x** | | | **LD-P HEVC 1.5x** | | |
| Y | U | V | Y | U | V |
| Class A |  |  |  |  |  |  |
| Class B | 0.6% | 0.6% | 0.5% | 0.7% | 0.7% | 0.7% |
| **Overall** | **0.6%** | **0.6%** | **0.5%** | **0.7%** | **0.7%** | **0.7%** |
| Enc Time (EL/BL) | **73.1%** | | | **73.5%** | | |

## SNR scalability

Table 3 shows the performance of the proposed algorithm in terms of BD-rate and encoding time for SNR scalability.

Table 3. Performance of the proposed algorithm for SNR scalability (BL+EL)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **RA HEVC SNR** | | | **LD-P HEVC SNR** | | |
| Y | U | V | Y | U | V |
| Class A | 0.9% | 1.9% | 1.9% | 1.0% | 2.1% | 2.2% |
| Class B | 0.9% | 1.8% | 1.4% | 1.0% | 1.8% | 1.5% |
| **Overall** | **0.9%** | **1.8%** | **1.6%** | **1.0%** | **1.9%** | **1.7%** |
| Enc Time (EL/BL) | **78.9%** | | | **81.6%** | | |

# Patent rights declaration(s)

**KWU does not have any current or pending patent rights relating to the technology described in this contribution.**