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| *Title:* | Implicit derivation of weight factor for Generalized Residual Prediction | | |
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# Abstract

This contribution proposes implicit derivation of weight factor for Generalized Residual Prediction (GRP). A CU level flag is used to signal GRP and the weight factor for each PU is determined based on motion parameters. The method is implemented on SCE3.5 (JCTVC-M0109) software. It is reported that the BD-rate (EL+BL) changes compared to SHM1.0 are -1.4%, -1.5%, -1.8%, -2.8%, -2.7% ,-3.5%, -2.2%, -2.7% and -2.4% for RA 2x, RA 1.5x, RA SNR, LP 2x, LP 1.5x, LP SNR, LB 2x, LB 1.5x and LB SNR cases respectively. It is also reported that the proposed method achieves coding gain by 0.0% to -1.2% compared to SCE3.5 (one weight case: w=0, 1.0) without increase of encoding/decoding time. It is also reported that the proposed method reduces encoding time by 5.5% to 10.2% compared to SCE3.5 (two weight case: w=0, 0.5, 1.0) without significant coding loss (0.0% to 0.3%) except LP 2x, LP SNR and LB SNR cases (0.5% to 1.0%).

# Introduction

This contribution proposes an implicit derivation of the weight factor for Generalized Residual Prediction (GRP) depending on motion parameters. The proposed method is based on the GRP proposed by JCTVC-M0109 [1], which is summarized as follows:

* Signal one weight factor **W** from up to three candidates (0, 0.5 and 1.0) on CU level.
* Generate the second order residual by subtracting motion-compensated up-sampled base layer (with the enhancement-layer motion parameters) from up-sampled base-layer reconstruction. Especially, in the spatial scalability case, the up-sampling and motion compensation steps are combined into one operation to reduce the memory needs and computational complexity.
* Add the weighted second order residual to enhancement-layer prediction.
* Restrict GRP mode to 1) 8x8 PU and larger (uni-prediction case), and 2) 16x8/8x16 and larger (bi-prediction case) at encoder.

Searching an optimal weight factor **W** from several candidates increases complexity at encoder. Therefore, we propose to signal a CU-level GRP on/off flag and to derive the weight factor implicitly in order to reduce encoder complexity.

# Proposed method

In our proposal, the weight factor **W** in eq. 1 and 2 as described below is derived based on motion parameters, inter\_pred\_idc and merge\_flag, as shown in Table 1 for each PU. The weight factor W1 is set to 0.5, W2, W3 and W4 are set to 1.0. The difference between SCE3.5 [1] and this proposal is summarized as follows:

* Signal CU-level GRP on/off flag
* Derive a weight factor (either 0.5 or 1.0) depending on motion parameters in PU level

**Table 1: Weight factors for each motion parameters**

|  |  |  |
| --- | --- | --- |
| inter\_pred\_idc | merge\_flag | |
| 0 | 1 |
| Pred\_L0/Pred\_L1 | W1 | W3 |
| Pred\_BI | W2 | W4 |

In [1], the GRP for uni-prediction in SNR and Spatial scalability are formulated as follows:

[GRP for uni-prediction in SNR scalability]

PREDEL = **MC1**[REFEL, MVEL,LX] + **W**\*{**UP1**{RECBL} – **MC2**[ **UP2**{REFBL} , MVEL,LX ] } -(eq.1)

[GRP for uni-prediction in Spatial scalability]

PREDEL = **MC1**[REFEL, MVEL,LX] + **W**\*{**UP1**{RECBL} – **MCoUP**[ REFBL , MVEL,LX ] } -(eq.2)

where, the above terms are defined as follows:

* PREDEL is the prediction signal of the enhancement layer
* REFEL and REFBL are the temporal reference signals in the Enhancement and Base layers
* RECBL is the base layer reconstructed signal corresponding to the current enhancement layer block
* MVEL,LX is the EL motion vector selected from the EL reference picture list X
* **UPx**{.} is the up-sampling operator x
* **MCx**[I,MV] is the motion compensation operator x of the current block using I as reference picture and MV for the motion vector.
* **MCoUP[I,MV]** is the operation which combined UPx{} and MCx{} into one step.
* **W** is the weighted value for the second order residuals

# Experimental results

The proposed method is implemented on SCE 3.5 [1] software and evaluation is done based on the test condition described in SCE3 document [4]. Table 2, 3 and 4 show the performance of the proposed method compared to SHM1.0, SCE3.5 (one weight case: W=0, 1) and SCE3.5 (two weight case: W=0, 0.5 and 1) respectively. Table 5 shows the summary of the complexity assessment of the proposed method. Please see the attached excels in more details.

It is observed that the proposed method achieves coding gain by 0.0% to -1.2% compared to SCE3.5 (one weight case) as shown in Table 3 without increase of encoding time.

It is also observed that the proposed method reduces encoding time by about 5.5% to 10.2% compared to SCE3.5 (two weight case) as shown in Table 4 without significant coding loss (0.0% to 0.3%) except LP 2x, LP SNR and LB SNR cases (0.5% to 1.0%).

Table 2: Performance of the proposal (ref. SHM1.0)



Table 3: Performance of the proposal (ref. SCE3.5 (one weight case: W=0, 1))   


Table 4: Performance of the proposal (ref. SCE3.5 (two weight case: W=0, 0.5 and 1))



Table 5: Summary of the complexity assessment of the proposal



# Conclusion

This contribution proposes implicit derivation of weight factor for Generalized Residual Prediction (GRP). A CU level flag is used to signal GRP and a weight factor for each PU is determined based on motion parameters. The method is implemented on SCE3.5 (JCTVC-M0109) software. It is reported that the BD-rate (EL+BL) changes compared to SHM1.0 are -1.4%, -1.5%, -1.8%, -2.8%, -2.7% ,-3.5%, -2.2%, -2.7% and -2.4% for RA 2x, RA 1.5x, RA SNR, LP 2x, LP 1.5x, LP SNR, LB 2x, LB 1.5x and LB SNR cases respectively. It is also reported that the proposed method achieves coding gain by 0.0% to -1.2% compared to SCE3.5 (one weight case: w=0, 1.0) without significant encoding/decoding time increase. It is also reported that the proposed method reduces encoding time by 5.5% to 10.2% compared to SCE3.5 (two weight case: w=0, 0.5, 1.0) without significant coding loss (0.0% to 0.3%) except LP 2x, LP SNR and LB SNR cases (0.5% to 1.0%). It is proposed to adopt this method into SHM.

# Reference

1. [E. François](mailto:edouard.francois@crf.canon.fr), et.al, “SCE3.5: Simplification of Generalized Residual Inter-Layer Prediction for spatial scalability”, JCTVC-M0109, Incheon, KR, 18–26 Apr. 2013.
2. X. Li, et.al, “Description of Tool Experiment SCE3: Combined Inter and Inter-Layer Prediction in SHVC,” JCTVC-L1103, Geneva, CH, Jan. 2013.

# Patent rights declaration(s)

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