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(54) Title: REMOVAL OF PARSING DEPENDENCY FOR ILLUMINATION COMPENSATION

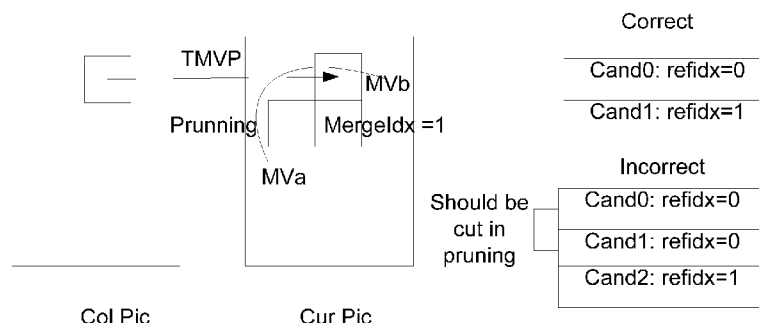


Fig.1

(57) Abstract: In this proposal, a method to remove the parsing dependency for illumination compensation (IC) in 3D HEVC is proposed. For a slice with both inter-view and inter-time references in the reference list, two modifications are applied to overcome the parsing dependency problem. Experimental results reveal that the proposed method provides the similar coding performance compared with the anchor.

REMOVAL OF PARSING DEPENDENCY FOR ILLUMINATION COMPENSATION

TECHNICAL FIELD

The invention relates generally to Three-Dimensional (3D) video processing. In particular, the present invention relates to improvement on illumination compensation (IC).

BACKGROUND

Illumination Compensation (IC) has been adopted into HTM [1][2][3]. Linear IC model is used to compensate illumination discrepancy between different views. Parameters in IC model are estimated for each PU using available nearest reconstructed neighbouring pixels and therefore are not need to be encoded. Applying IC or not is decided at CU level, and an IC flag is coded for each non-intra CU in which inter-view prediction is used.

Moreover, to provide adaptive IC on slice-level, the encoder decides whether the IC should be applied or not to current picture and transmits the decision result to decoder. One bit flag is encoded in the slice header of the first slice to indicate whether IC is applied for the first slice and its subsequent slices in the picture. The decision process is shown in Table1. The colour distributions of the current and inter-view reference pictures are represented by histograms and the similarity of two distributions are measured by SAD of the two histograms. The threshold is determined by preliminary experiments. When the flag is turned off, the encoder does not try IC applied case for CU and the CU-level flags are not transmitted to decoder. Therefore, inefficient IC process can be prevented at both encoder and decoder.

Table 1. The decision process of the picture level IC flag

1) Make histograms of the current picture and the inter-view reference original picture
2) Calculate SAD between two histograms
3) If the SAD is over a certain threshold, the IC flag is set to 1
4) else, the IC flag is set to 0

Although IC can provide a significant coding gain, it brings about a parsing dependency into HTM. Since `ic_flag` is only signalled for inter CU in which inter-view prediction is used, the parser must examine whether an inter-view reference is used or not, to determine whether `ic_flag` should be parsed or not in the current CU.

- 5 Obviously, `ic_flag` should always be parsed if only inter-view references are in the reference list and it should never be parsed if only inter-time references are there. There is no parsing dependency under these two situations.

The problem arises when both inter-view and inter-time references are in the reference list. If all PUs in the current CU are coded in non-merge mode, there is no parsing dependency since all the reference pictures used are explicitly signalled by reference indices. However, the reference picture used for a PU coded in merge mode is not explicitly signalled. Instead, it is derived from the selected merging candidate. Due to the pruning process in merging candidate construction, the derived reference picture depends on Motion Vectors (MV) in its neighbouring blocks. Because MVs in neighbouring blocks may come from the collocated picture, the derived reference picture depends on the collocated picture indirectly. If the collocated picture is damaged, a parsing problem for `ic_flag` may come out.

Fig.1 demonstrates an example to explain this indirect parsing dependency more clearly. In this example, Ref 0 and Ref 1 are inter-time and inter-view references respectively. The current CU is coded in $2N \times 2N$ merge mode with merge index 1. The reference indices derived from the first three candidates are 0, 0, and 1. The MVs derived from the first two candidates denoted as MV_a and MV_b are equal, *a.e.*, $MV_a = MV_b$. In addition, MV_b is obtained by Temporal Motion Vector Prediction (TMVP) from the collocated picture. In the merging candidate pruning process, the second possible candidate is cut since it is equal to the first one. Therefore, merge index 1 refers to the third possible candidate with an inter-view reference. As a result, `ic_flag` should be parsed for this CU. However, this result implies an indirect dependency on the collocated picture. If the collocated picture is damaged, then TMVP will be wrong, and MV_b will be wrong sequentially. Since $MV_a \neq MV_b$ incorrectly, the second possible candidate will not be cut. In this case, merge index 1 will refer to the second possible candidate with an inter-time reference, and `ic_flag` should not be parsed for this CU. A parsing problem will arise.

SUMMARY

In light of the previously described problems, this contribution presents a method to remove the parsing dependency for illumination compensation in 3D HEVC. In the current HTM, illumination compensation brings about a parsing dependency on the collocated picture. A parsing problem may arise if the collocated picture is damaged. To remove such a dependency, several modifications are proposed when both inter-view and inter-time references are in the reference list. First, `ic_flag` is only signalled for an inter CU with one $2N \times 2N$ PU in non-merge mode. Second, `ic_flag` is derived from the selected merging candidate just like other motion information for a PU in merge mode. Experimental results show that the proposed method causes little BD-rate loss by removing the parsing dependency for illumination compensation.

We also propose to always signal the IC flag for every non-intra CUs. To reduce the overhead of IC flag signaling, we also propose several methods to enable or disable illumination compensation at picture or slice level. For those pictures or slices with IC disabled, the CU-level IC flag is not needed to be signaled and vice versa, for those pictures with IC enabled, IC flag is signaled for each non-intra CU.

Other aspects and features of the invention will become apparent to those with ordinary skill in the art upon review of the following descriptions of specific embodiments.

BRIEF DESCRIPTION OF DRAWINGS

The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

Fig. 1 is a diagram illustrating an example of parsing problem for IC.

DETAILED DESCRIPTION

The following description is of the best-contemplated mode of carrying out the invention. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of

the invention is best determined by reference to the appended claims.

This contribution presents a method to remove the parsing dependency for IC. For a slice with only inter-view or inter-time references in the reference list, nothing is changed. For a slice with both inter-view and inter-time references in the reference list,
5 and IC is enabled at slice level, two modifications are made as follows.

1. `ic_flag` is only signalled for an inter CU with one $2N \times 2N$ PU in. For PUs with other sizes in non-merge mode, IC is disabled.

2. `ic_flag` is derived from the selected merging candidate just like other motion information for a PU in merge mode.

10 Because `ic_flag` is never signalled for a CU with PUs coded in merge mode, the parsing dependency is removed completely.

Since the `ic_flag` may be derived from a temporal merging candidate, `ic_flag` in the collocated picture should be stored as other motion information in a compression form.

15 If `ic_flag` in the collocated picture is not stored, `ic_flag` cannot be shared from a temporal merging candidate. In this case, IC is turned off on a PU merged from a temporal candidate.

When IC is allowed in a coded slice or coded picture, the following approaches can also be applied to all the CUs within the coded slice or picture to remove the
20 parsing dependency created by IC.

1. If there are both inter-view and inter-time references in the reference list, `ic_flag` is only signalled for an inter CU with one or more PUs coded in non-merge mode, and IC is turned off for PUs coded in merge mode.

2. If there are both inter-view and inter-time references in the reference list,
25 `ic_flag` is only signalled for an inter CU with one or more PUs coded in non-merge mode, and `ic_flag` for a PU in merge mode is derived from the selected merging candidate just like other motion information.

3. If there are both inter-view and inter-time references in the reference list, `ic_flag` is signalled when one or more PUs in the current CU are coded in merge mode.

- 30 4. `ic_flag` is always signalled for all CUs. However, IC only takes effect for inter-view prediction.

5. `ic_flag` is always signalled for all CUs. And IC takes effect for both inter-view and inter-time prediction.

6. `ic_flag` is always signalled for all CUs. And IC takes effect for inter-view,

inter-time prediction and view synthesis prediction.

7. `ic_flag` is always signalled for all non-intra CUs. However, IC only takes effect for inter-view prediction.

5 8. `ic_flag` is always signalled for all non-intra CUs. And IC takes effect for both inter-view and inter-time prediction.

9. `ic_flag` is always signalled for all non-intra CUs. And IC takes effect for inter-view, inter-time prediction and view synthesis prediction

To reduce the bits overhead to transmit the CU-level IC flags, we also propose different methods to adaptively enable/disable IC for each slice or picture.

10 If current picture/slice is a random access point (RAP) picture/ slice, the IC flag is set to 1; otherwise the IC flag is set to 0.

Comparing the Picture Order Count (POC) of current picture and each reference picture, if all the absolute POC differences of the reference pictures are larger than a threshold, the IC flag is set to 1; otherwise, the IC flag is set to 0.

15 Calculate the SAD between two color histograms of the current picture and the inter-view reference picture and comparing the POC of current picture and each reference picture, if the histogram SAD is over a certain threshold and all the absolute POC differences of the reference pictures are larger than another threshold, the IC flag is set to 1; otherwise, the IC flag is set to 0.

20 All the proposed scheme can be apply to chroma components.

CLAIMS

1. A method of removing parsing dependency for illumination compensation (IC) in three-dimensional video coding (3DVC).
2. The method as claimed in claim 1, wherein a signalling method of `ic_flag`
5 depends on whether there are only inter-time, only inter-view, or both inter-view and inter-time references in a reference list.
3. The method as claimed in claim 2, wherein `ic_flag` is never signalled in a slice where only inter-time references are in the reference list.
4. The method as claimed in claim 2, wherein `ic_flag` is signalled for each
10 inter-coded CU in a slice where only inter-view references are in the reference list.
5. The method as claimed in claim 2, wherein `ic_flag` is only signalled for an inter-coded CU with one or more PUs coded in non-merge mode, and IC is applied or not on these PUs according to the `ic_flag` signalled.
6. The method as claimed in claim 5, wherein `ic_flag` is only signalled for an
15 inter-coded CU with one 2Nx2N PU coded in non-merge mode, and IC is applied or not on this PU according to the `ic_flag` signalled; for PUs with other sizes in non-merge mode, IC is disabled.
7. The method as claimed in claim 2, wherein `ic_flag` is derived from a selected merging candidate the same way as motion information for a PU in merge
20 mode; and IC is applied or not on this PU according to the `ic_flag` derived.
8. The method as claimed in claim 7, wherein `ic_flag` is derived from a temporal merging candidate; `ic_flag` in the collocated picture is stored as other motion information in a compression form.
9. The method as claimed in claim 7, wherein `ic_flag` is not derived from a
25 temporal merging candidate; and IC is not applied on a PU merged from a temporal candidate.
10. The method as claimed in claim 1, wherein IC is applied on PUs coded in merge mode.
11. The method as claimed in claim 2, wherein `ic_flag` is signalled when one
30 or more PUs in a current CU are coded in merge mode; IC is applied or not on PUs using inter-view prediction in this CU according to the `ic_flag` signalled.
12. The method as claimed in claim 2, wherein `ic_flag` is always signalled for all CUs; and IC is applied or not on PUs using inter-view prediction in this CU

according to the ic_flag signalled.

13. The method as claimed in claim 2, wherein ic_flag is always signalled for all CUs; and IC is applied or not on PUs in this CU according to the ic_flag signalled.

14. The method as claimed in claims 5 –11, wherein the statements in claim 5
5 –11 take effect only if there are both inter-view and inter-time references in the reference list.

15. A method to determine whether the IC is applied or not to a current picture or slice, and transmits the decision result to decoder.

16. The method as claimed in claim 15, wherein if the current picture/slice is a
10 random access point (RAP) picture/ slice, an IC flag is set to 1; otherwise the IC flag is set to 0.

17. The method as claimed in claim 15, further comprising comparing a picture order count (POC) of the current picture and each reference picture, if all absolute POC differences of the reference pictures are larger than a threshold, an IC
15 flag is set to 1; otherwise, the IC flag is set to 0.

18. The method as claimed in claim 15, further comprising calculating a SAD between two color histograms of the current picture and an inter-view reference picture and comparing the POC of the current picture and each reference picture, if the histogram SAD is over a certain threshold and all absolute POC differences of the
20 reference pictures are larger than another threshold, the IC flag is set to 1; otherwise, the IC flag is set to 0.

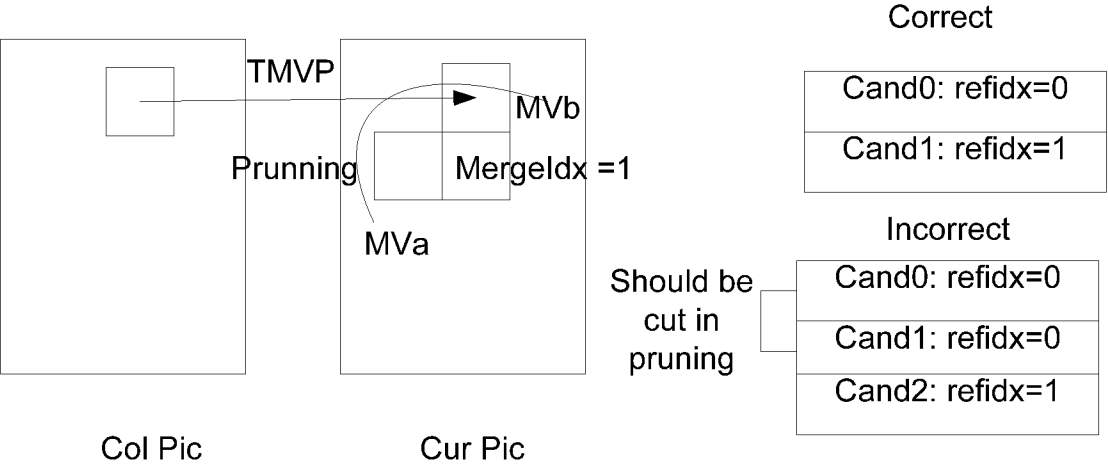


Fig.1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2013/074136

A. CLASSIFICATION OF SUBJECT MATTER

H04N 7/32 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04W, H04Q, H04L, H04B, H04J, H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC, IEEE: three w dimensional w video w coding, 3dvc,illumination, compensat+, ic, id, flag, inter w view, inter w time, remov+, eliminat+, pars+, dependency

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 101715652 A (SAMSUNG ELECTRONICS CO., LTD. et al.) 26 May 2010 (26.05.2010) description, paragraphs [0010] to [0072]	15-18
Y		1-14
Y	CN 101790091 A (UNIVERSITY-INDUSTRY COOPERATION GROUP OF KYUNG HEE UNIVERSITY) 28 July 2010 (28.07.2010) description, paragraphs [0011] to [0075]	1-14

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
“A” document defining the general state of the art which is not considered to be of particular relevance	“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
“E” earlier application or patent but published on or after the international filing date	“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
“L” document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)	“&” document member of the same patent family
“O” document referring to an oral disclosure, use, exhibition or other means	
“P” document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 24 December 2013(24.12.2013)	Date of mailing of the international search report 16 Jan. 2014 (16.01.2014)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer ZHONG, Maojian Telephone No. (86-10)62413360

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/074136

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 101715652 A	26.05.2010	WO 2009002092 A2	31.12.2008
		US 2009010340 A1	08.01.2009
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		EP 2165544 A2	24.03.2010
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