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(54) Title: METHODS FOR CHROMA COMPONENT CODING WITH SEPARATE INTRA PREDICTION MODE

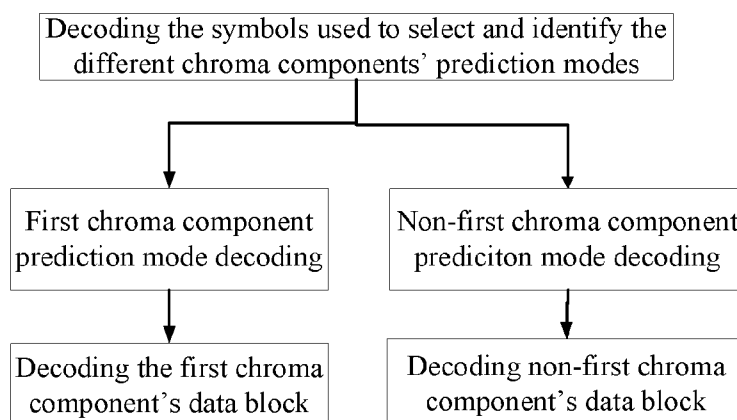


Fig. 3

(57) Abstract: Methods of chroma intra prediction for general videos are disclosed. Several methods are proposed for coding the chroma components with their own prediction modes, and even their own contexts.



METHODS FOR CHROMA COMPONENT CODING WITH SEPARATE INTRA PREDICTION MODE

TECHNICAL FIELD

[0001] The invention relates generally to video coding process, including
5 general video, Screen Content (SC) video, multi-view video and Three-Dimensional
(3D) video processing. In particular, the present invention relates to methods for how
to generate the prediction data for each chroma component.

BACKGROUND

[0002] In intra prediction, there are multiple directional intra prediction
10 candidates. For example, in HEVC, the relationship between variable *intraPredAngle*
and the corresponding direction index is shown in Fig. 1 and Table 1. Each intra
direction predicts the sample at position (x, y) of one Prediction Unit (PU) by
 $((32-iFact) \times ref[x+idx+1] + iFact \times ref[x+idx+2] + 16) \gg 5$, when the direction is
relatively vertical (the direction index corresponding to the direction *intraPredAngle*
15 is greater than or equal to 18). In this expression, the array *ref* is the decoded line
buffer above the current PU, *idx* is the floor position of the pixel in *ref* which (x, y)
points to along the intra direction (i.e., $idx = ((y+1) \times intraPredAngle) \gg 5$), and *iFact*
is the distance between the floor position and pointed position (i.e., $iFact = ((y+1) \times intraPredAngle) \& 31$).

[0003] Beside these directions, DC and Planar modes are also utilized in
20 HEVC. Beyond HEVC, well-known intra prediction methods include linear-model (LM)
chroma intra prediction, single depth intra mode and so on. Single depth intra mode, as
referred in [JCT3V-H0087], utilizes one predicted value from neighboring
reconstructed samples as the prediction values for all inside samples without
25 transmitting the prediction residuals; LM chroma intra prediction, as referred in JCTVC-
L0240 and JCTVC-M0116, predicts chroma data from luma data by a linear model.
As described in Fig. 2, according which neighboring samples are utilized as reference,
LM chroma prediction modes can be further classified into Top+Left LM, TopOnly
and LeftOnly modes, which are collectively referred to as Multi-LM chroma modes.

(a) Left+Top LM chroma mode; (b) Left-Only LM chroma modes; (c) Top-Only LM chroma modes.

Table 1. Specification of intraPredAngle

pred Mod eIntr a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
intra Pred Ang le	-	32	26	21	17	13	9	5	2	0	-2	-5	-9	-13	-17	-21	-26
pred Mod eIntr a	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
intra Pred Ang le	-32	-26	-21	-17	-13	-9	-5	-2	0	2	5	9	13	17	21	26	32

[0004] One common point of the above intra prediction methods is that, luma and chroma components can have different intra prediction modes through the transmission of 2 flags respectively for luma and chroma coding blocks. Moreover, the blocks for different chroma components must utilize the same prediction modes. As shown in table II for HEVC intra prediction mode transmission, only one flag of intra_chroma_pred_mode[x0][y0] is utilized to indentify the prediction mode for both Cb and Cr chroma components.

Table 1. Specification of intra_chroma_pred_mode

if(CuPredMode[x0][y0] == MODE_INTRA) {	
.....	
if(pcm_flag[x0][y0]) {	
.....	
} else {	
.....	
intra_chroma_pred_mode[x0][y0]	ae(v)
}	
} else {	

[0005] The problem is that, different chroma prediction blocks do not always utilize the same prediction mode. Therefore, it is proposed to transmit separate flags for different chroma components to indentify these components' prediction modes and

code each chroma components with separate intra prediction mode.

SUMMARY

5 [0006] It is proposed to permit utilizing different prediction modes for different chroma components while coding kinds of non-4:0:0 videos in this application.

[0007] In practical video codec, typically at the decoder side, the method has following important procedures.

10 [0008] (1) Decoding the symbols used to identify the chroma prediction modes. For example, two flags respectively for Cb and Cr components can be transmitted to identify their prediction modes. Another feasible way is to transmit one flag to indentify different combinations of Cb and Cr's prediction modes.

15 [0009] (2) Separate prediction mode decoding. For example, among the normal Cr and Cr chroma components, when Cr component prediction mode can be transmitted after Cb prediction mode, Cb prediction mode can be utilized as one candidate for Cr component. In such case, a more efficient chroma prediction mode coding method is proposed in this patent application.

[0010] At the encoder side, procedures corresponding to the decoding procedures are necessarily required.

20 [0011] Fig. 3 presents one decoding procedure example for the proposed method. One example for the proposed decoding process of chroma components.

[0012] 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

25 [0013] The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

[0014] Fig. 1 is a diagram illustrating the common-used intra prediction directions in HEVC.

30 [0015] Fig. 2 is a diagram illustrating the referred different kinds of Multi-LM

chroma modes.

[0016] Fig. 3 is a diagram illustrating one example for the proposed decoding process of chroma components.

5

DETAILED DESCRIPTION

[0017] 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.

10 [0018] The procedure of this method can be divided into steps of (1) Constructing candidate mode sets for different chroma components, including the first chroma component and non-first chroma components. (2) Using flags to select and identify best prediction modes for these chroma components. (3) Coding the binarization result of these best prediction modes and information for the component's
15 prediction residuals. Results show the method can achieve more than 1% bit-savings on the second chroma component.

[0019] A first embodiment of step (1), the i -th chroma component's candidate mode set includes $M(i)$ modes from PLANAR, DC, HOR, VER, TOP+LEFT LM, OnlyTop LM, OnlyLeft LM, DM and so on, where $M(i)$ is larger than 0 for any index
20 i .

[0020] A second embodiment of step (1), the non-first chroma component prediction mode set can include one special designed prediction mode, namely the CB_DM mode, which makes the non-first chroma component inherit the first component's prediction mode.

25 [0021] A third embodiment of step (1), the non-first chroma component prediction mode set can include one special designed prediction mode, namely the PRE_DM mode, which makes the k -th chroma component inherit the $k-1$ -th component's prediction mode.

[0022] A first embodiment of step (2), there are separate flags to be encoded
30 and decoded to indentify the prediction modes of different chroma components.

[0023] A second embodiment of step (2), flags are utilized to signal the combination of different chroma components' prediction modes. For example, using

one flag equal to 0 to denote both Cb and Cr components' prediction mode are DM (derived mode), which means chroma prediction modes are the same as luma prediction mode.

5 [0024] A third embodiment of step (2), flags for the second chroma component prediction mode is only transmitted when the prediction mode of the first component belongs to a limited set of prediction modes.

 [0025] Another embodiment of step (2), the second chroma component prediction mode can be derived from neighboring block's second chroma component prediction mode.

10 [0026] Another embodiment of step (2), if the prediction mode of the current chroma component is CB_DM, the prediction mode of the first chroma component will be selected for the current chroma component.

 [0027] Another embodiment of step (2), if the decoded prediction mode of the current chroma component is PRE_DM, the prediction mode of its before chroma component will be selected for the current chroma component.

 [0028] A first embodiment of step (3), the coding and transmission of these chroma components' residual data can be either after the coding and transmission of their corresponding component's prediction mode flags or after all the chroma prediction mode flags are coded and transmitted.

20 [0029] Another embodiment of step (3), there is no overlap between the arithmetic coding contexts utilized to signal the i -th chroma component's prediction mode and those for the j -th chroma component's, when i is not equal to j .

 [0030] Another embodiment of step (3), there is no overlap between the arithmetic coding contexts utilized to signal the i -th chroma component's coding symbols for the prediction residuals and those of the j -th chroma component's, when i is not equal to j .

 [0031] Another embodiment of step (3), the CB_DM or PRE_DM mode of the non-first chroma component is signaled in stream with the shortest binarization length.

30 [0032] Another embodiment of step (3), the DM mode of non-first chroma component is not signaled with the shortest binarization length. For example, 2 symbols are utilized to signalize the overall four candidate chroma modes among DM, Planar, DC, VER, HOR and so on.

 [0033] Another embodiment of step (3), beyond the contexts for signaling the candidate DM mode or any Multi-LM chroma mode, there are no less than 1

arithmetic coding contexts utilized to signal the other candidate chroma modes.

5 **[0034]** The proposed method described above can be used in a video encoder as well as in a video decoder. Embodiments of the method according to the present invention as described above may be implemented in various hardware, software
10 codes, or a combination of both. For example, an embodiment of the present invention can be a circuit integrated into a video compression chip or program codes integrated into video compression software to perform the processing described herein. An embodiment of the present invention may also be program codes to be executed on a Digital Signal Processor (DSP) to perform the processing described herein. The
15 invention may also involve a number of functions to be performed by a computer processor, a digital signal processor, a microprocessor, or field programmable gate array (FPGA). These processors can be configured to perform particular tasks according to the invention, by executing machine-readable software code or firmware code that defines the particular methods embodied by the invention. The software
20 code or firmware codes may be developed in different programming languages and different format or style. The software code may also be compiled for different target platform. However, different code formats, styles and languages of software codes and other means of configuring code to perform the tasks in accordance with the invention will not depart from the spirit and scope of the invention.

25 **[0035]** The invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described examples are to be considered in all respects only as illustrative and not restrictive. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims
30 should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

CLAIMS

1. A method of chroma-component intra prediction for video/image coding, wherein different chroma components can have different prediction modes.
2. The method as claimed in claim 1, wherein the method can comprise the
5 following steps of
 - Constructing candidate mode sets for different chroma components separately,.
 - Selecting best prediction modes for different chroma components separately.
 - 10 - Signaling the information of the best prediction modes for different chroma components separately.
3. The method as claimed in claim 2, wherein there are $M(i)$ modes in the i -th chroma component's candidate mode set, including but not limited to. PLANAR, DC, HOR, VER, TOP+LEFT LM, OnlyTop LM, OnlyLeft LM, DM, the new designed
15 CB_DM and PRE_DM prediction modes. $M(i)$ is larger than 0 for any index i .
4. The method as claimed in claim 3, wherein the non-first chroma component in the CB_DM mode inherits the first chroma component's prediction mode.
5. The method as claimed in claim 3, wherein the k -th chroma component in
20 the PRE_DM mode inherits the $(k-1)$ -th component's prediction mode.
6. The method as claimed in claim 2, wherein in the chroma-component prediction mode selection procedure, different chroma component can have different prediction modes.
7. The method as claimed in claim 6, wherein a value X can be signaled to
25 indicate the combination of different chroma components' prediction modes, In an exemplary combination, first chroma component's prediction mode is HOR and second chroma component's prediction mode is VER.
8. The method as claimed in claim 7, wherein X equal to 0 can indicate both CB and CR's prediction mode are DM modes
- 30 9. The method as claimed in claim 6, wherein the second chroma component prediction mode is only signaled when the prediction mode of the first component belongs to a limited set of prediction modes.
10. The method as claimed in claim 6, wherein separate syntax elemnts are

encoded and decoded to indicate the prediction modes of different chroma components.

11. The method as claimed in claim 6, wherein if the prediction mode of the second chroma component is CB_DM, the prediction mode of the first chroma component will be used for the second chroma component.

12. The method as claimed in claim 6, wherein if the decoded prediction mode of the k th chroma component is PRE_DM, the prediction mode of the $k-1$ th chroma component will be used for the k th chroma component.

13. The method as claimed in claim 2, wherein for the procedure of signaling the information of the best prediction modes, multiple chroma-component prediction modes are transmitted in video stream and utilized to decode different chroma components.

14. The method as claimed in claim 13, wherein the transmission of first and non-first chroma component residual data can be either after the transmission of their corresponding component's prediction mode flags or after all the chroma components' prediction mode flags are transmitted.

15. The method as claimed in claim 13, wherein the arithmetic coding contexts are different for the i -th chroma component's prediction mode and those for the j -th chroma component's, when i is not equal to j .

16. The method as claimed in claim 13, wherein the arithmetic coding contexts are different for the transformed or untransformed residuals of the i -th chroma component and of the j -th chroma component, when i is not equal to j .

17. The method as claimed in claim 13, wherein the CB_DM or PRE_DM mode of the non-first chroma component is binarized with the shortest binarization length.

18. The method as claimed in claim 13, wherein the DM mode of non-first chroma component is binarized with the binarization length longer or equal to that of the CB_DM or PRE_DM mode.

19. The method as claimed in claim 13, wherein the chroma mode for one non-first chroma component is binarized as a fixed length codeword with n bits when the mode is not CB_DM, PRE_DM, and any Multi-LM chroma mode, but can be DM.

20. The method as claimed in claim 13, wherein for the first chroma component, beyond the contexts for signaling the candidate DM mode or any Multi-

LM chroma mode, there are no less than 1 contexts utilized to signal the other candidate chroma modes.

21. The method as claimed in claim 11, wherein for one non-first chroma component, beyond the contexts for signaling the CB_DM, PRE_DM mode or any
5 Multi-LM chroma mode, there is no less than 1 context utilized to signal the other candidate chroma modes.

22. The method as claimed in claim 2, wherein another more-detailed coding process of the method for videos with two chroma components includes the following steps at least.

10 - Candidate modes construction. Constructing different candidate mode sets for the first and second chroma components. CB_DM mode is added into the candidate set for the second chroma component.

- Mode Selection. For one encoding process, a mode decision process is conducted to select the best combination of modes for different components,
15 including cases of different components having the same modes and different components having different modes. For one decoding process, the prediction mode for each component is obtained through flag parsing.

- Obtaining Prediction data. Obtaining the prediction data for each chroma data block. If the selected mode is CB_DM, the first chroma component's prediction
20 mode should be selected to get the second chroma component's prediction data.

- Flag and residual Transmission. Mode flags and prediction residual coding data Transmission. Different order can be followed: The best mode of the first chroma component with the information for its prediction residuals followed by the best mode of the second chroma component with the information for its prediction residuals, Or
25 the best modes of the first and second chroma component followed by their information for its prediction residuals.

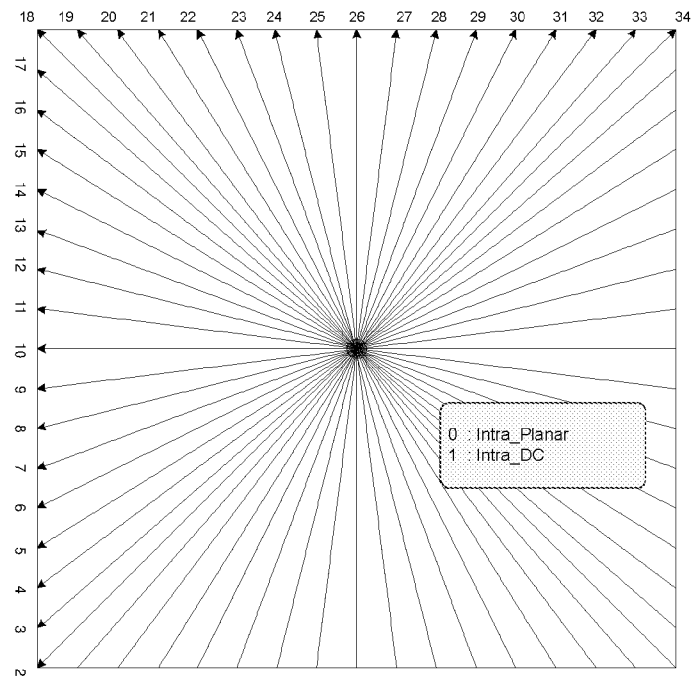


Fig. 1

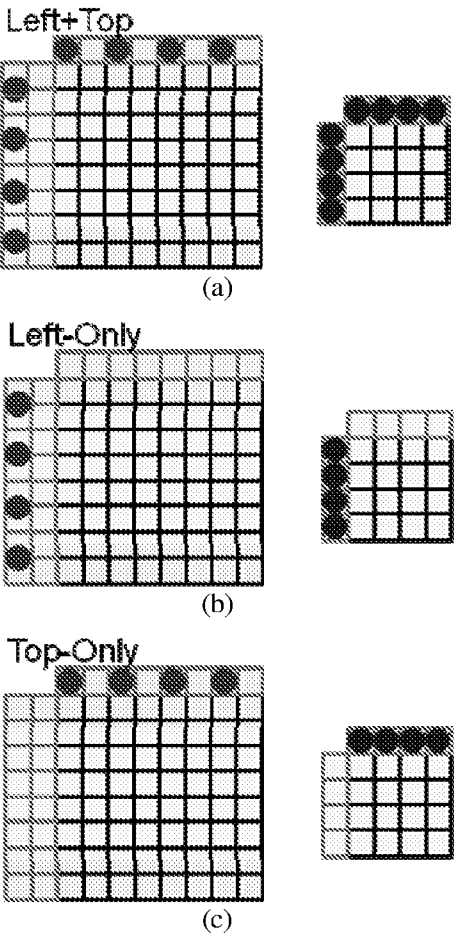


Fig 2

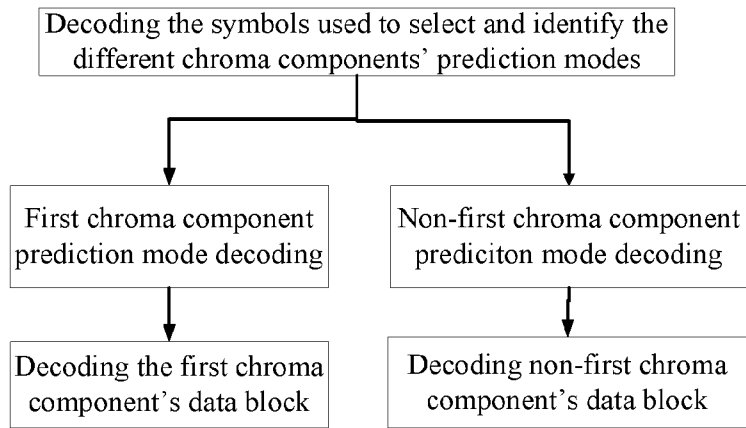


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/071341

A. CLASSIFICATION OF SUBJECT MATTER

H04N 19/50(2014.01)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)

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:image, video, intra prediction, chroma, color, component?, select+, different, mode?, horizontal, HER, vertical, VER

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011032987 A1 (SAMSUNG ELECTRONICS CO., LTD.) 10 February 2011 (2011-02-10) the abstract, description, paragraphs [0015], [0031], [0035], [0041], [0044], [0051], [0056], [0066], [0068], [0072], and figures 2-6	1-21
A	CN 103220508 A (HUAWEI TECHNOLOGIES CO., LTD.) 24 July 2013 (2013-07-24) the whole document	1-22
A	CN 103096051 A (HUAWEI TECHNOLOGIES CO., LTD.) 08 May 2013 (2013-05-08) the whole document	1-22
A	CN 101222645 A (MITSUBISHI ELECTRIC CORP.) 16 July 2008 (2008-07-16) the whole document	1-22

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Information on patent family members

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