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(54) **Title**: METHODS FOR INTRA PREDICTION

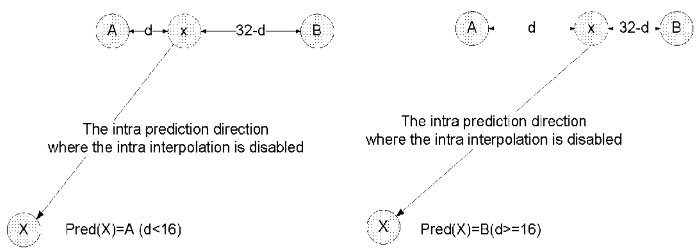

Fig. 4

(57) **Abstract**: Methods of intra prediction for multi-view video coding, 3D video coding and screen content video coding are disclosed. Several methods are proposed for predicting the sample of one prediction unit at the each intra prediction direction. A nearest sample prediction method is also proposed to replace the intra interpolation.

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METHODS FOR INTRA PREDICTION

FIELD OF INVENTION

The invention relates generally to Multi-view Video, Three-Dimensional (3D) video and Screen Content (SC) video processing. In particular, the present invention relates to optimized methods for intra prediction in 3D and SC video coding.

BACKGROUND OF THE INVENTION

3D video coding is developed for encoding or decoding video data of multiple views simultaneously captured by several cameras. SC video coding is developed for encoding and decoding video data directly recording the digital display screens. As usual, intra prediction is also effective in remove the spatial redundancy of texture and depth videos in 3D video coding standard (3D-HEVC) and SC video coding standard (HEVC-REXT).

Table 1. Specification of intraPredAngle

predModeIntra	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
intraPredAngle	-	32	26	21	17	13	9	5	2	0	−2	−5	−9	−13	−17	−21	−26
predModeIntra	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**
intraPredAngle	−32	−26	−21	−17	−13	−9	−5	−2	0	2	5	9	13	17	21	26	32

In intra prediction, there are multiple directional intra prediction candidates. 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 $((32-iFact)\times ref[x+iIdx+1]+iFact\times ref[x+iIdx+2]+16) >> 5$, when the direction is relatively vertical (the direction index corresponding to the direction intraPredAngle 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., $idx=((y+1)\times intraPredAngle)>>5$), and iFact is the distance between the floor poistion and pointed position (i.e., iFact =((y+1) × intraPredAngle)&31).

Similar process works when the intra prediction direction is relatively horizontal (the direction index corresponding to variable intraPredAngle is smaller than 18). In that case, idx=((x+1) × intraPredAngle)>>5 and iFact =((x+1) × intraPredAngle)&31.

In this application, we utilize the concept of "intra interpolation" to denote the prediction sample calculation at (x, y) from (ref[x+iIdx+1], ref[x+iIdx+2]) when intraPredAngle≥18 and from (ref[y+iIdx+1], ref[y+iIdx+2]) when intraPredAngle<18.

Such above intra interpolation works under one assumption that the PU border is smooth. However, for the depth video in 3D applications and SC videos, such assumption is not strictly followed.

SUMMARY OF THE INVENTION

It is proposed to replace the intra interpolation by a nearest sample prediction method at limited conditions for 3D videos and SC videos in this application.

In practical video codecs, there are two kinds of methods to disable the intra interpolation for depth videos in 3D videos and general SC videos.

(1) With signification flags. Codecs can select to disable the intra interpolation for all or only part of the intra prediction directions according to the signification flags at sequence parameter set (SPS), picture parameter set (PPS), video parameter set (VPS), slice, coding tree unit (CTU), coding unit (CU) or prediction unit (PU) levels.

(2) Without signification flags. Codecs can forbid the usage of intra interpolation for all intra prediction directions or only disable intra interpolation for one group of directions.

When intra interpolation is disabled for one intra prediction direction, for the each sample, the predicted sample is set to the nearest sample of the pointed position along the intra prediction direction.

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 THE 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 the common-used intra prediction directions in, 3D-HEVC and HEVC-REXT.

Fig. 2 is a diagram illustrating the comparison of directions disabling intra interpolation and directions reserving intra interpolation, where the former ones are marked by one circle on each direction.

Fig. 3 is a diagram illustrating the sample prediction for position (x, y) under one vertical direction where intra interpolation is not disabled.

Fig. 4 is a diagram illustrating the sample prediction for position (x, y) under one vertical direction where intra interpolation is disabled.

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.

The optimization of this method can be divided into steps of a intra interpolation disabling and a nearest sample prediction, as shown in Fig. 2 and Fig. 4. The optimized intra prediction procedure for each intra PU is as the following:

Firstly, encoders and decoders should justify whether the current intra prediction direction disables the intra interpolation according to its intra prediction direction. In practice, encoders and decoders can justify by using fixed rules, (e.g., the Fig. 2, where the arrow with circle represents the directions where the intra interpolation is disabled). Besides, they can explicitly transmit flags in slice, picture, coding unit (CU), coding tree (CTU) or prediction unit (PU) levels to control the on/off of the intra interpolation for each intra prediction direction. The encoders can utilize some fixed rule, mode decision or rate-distortion decision methods to calculate the value of the flags, and the decoders just decode the flags and justify whether to carry out the intra interpolation.

Secondly, if the current intra prediction direction should not employ intra interpolation, a nearest sample prediction procedure is adopted. In this process, for the current sample, the predicted sample can be the nearest pixel of the pointed position along the current intra prediction direction. That is to say, each sample at position (x, y) of the current PU is predicted by (iFact>>4)?ref[x+iIdx+1]:[x+iIdx+2] when the intra prediction direction is relatively vertical, and by (iFact>>4)?ref[y+iIdx+1]:[y+iIdx+2] when the direction is relatively horizontal.

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 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 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 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.

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 should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

CLAIMS

1. A method of intra prediction for multi-view video coding, 3D video coding or screen content video coding, comprising:

disabling intra interpolation for at least one of intra prediction directions; and

predicting a current sample according to whether the intra interpolation is disabled.

2. The method as claimed in claim 1, wherein the intra interpolation for all intra prediction directions is disabled.

3. The method as claimed in claim 1, wherein the intra interpolation for a plurality of fixed intra prediction directions is disabled.

4. The method as claimed in claim 1, wherein the intra interpolation disabling is applied on dependent texture videos, depth videos or screen content videos.

5. The method as claimed in claim 1, wherein whether the intra interpolation disabling is applied depends on signification flags transmitted at TU level, PU level, CU level, LCU level, slice level, picture level, PPS, SPS or VPS.

6. The method as claimed in claim 3, wherein the codec disables intra interpolation for the intra prediction directions when the corresponding intraPredAngle is odd.

7. The method as claimed in claim 3, wherein disabling intra interpolation for the intra prediction directions obeys a rule of no two neighboring directions both disabling the intra interpolation.

8. The method as claimed in claim 7, wherein disabling intra interpolation for the intra prediction directions when a corresponding direction index is odd.

9. The method as claimed in claim 7, wherein disabling intra interpolation for the intra prediction directions when a corresponding intraPredAngle is equal to -5, -13, -21, 21,13 or 5.

10. The method as claimed in claim 1, wherein each sample is predicted just by one

reconstructed sample around an intra-prediction-direction pointed position, when the intra interpolation is disabled.

11. The method as claimed in claim 10, wherein each sample is predicted by a nearest sample, above sample, below sample, left sample or right sample of the intra-prediction-direction pointed position, when the intra interpolation is disabled.

12. The method as claimed in claim 1, wherein the intra interpolation for all intra prediction directions is disabled in depth coding.

13. The method as claimed in claim 1, wherein the intra interpolation for all intra prediction directions is disabled in a dependent view.

14. The method as claimed in claim 1, wherein the intra interpolation for all intra prediction directions is disabled in screen content video coding.

15. The method as claimed in claim 1, wherein a flag is transmitted in a layer level to indicate whether the intra interpolation is disabled in the layer.

16. The method as claimed in claim 1, wherein a flag is transmitted in a picture or slice level to indicate whether the intra interpolation is disabled for each picture or slice.

17. The method as claimed in claim 1, a significant map, significant table, or a set of significant flags is transmitted at TU level, PU level, CU level, LCU level, slice level, picture level, PPS, SPS or VPS to indicate on/off of intra interpolation for each intra prediction direction.

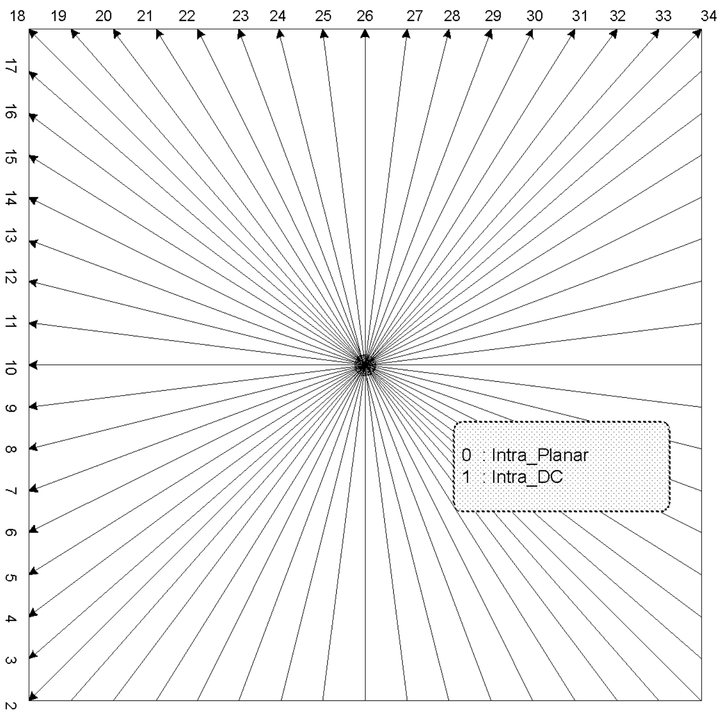
18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2
0 : Intra_Planar
1 : Intra_DC

Fig. 1

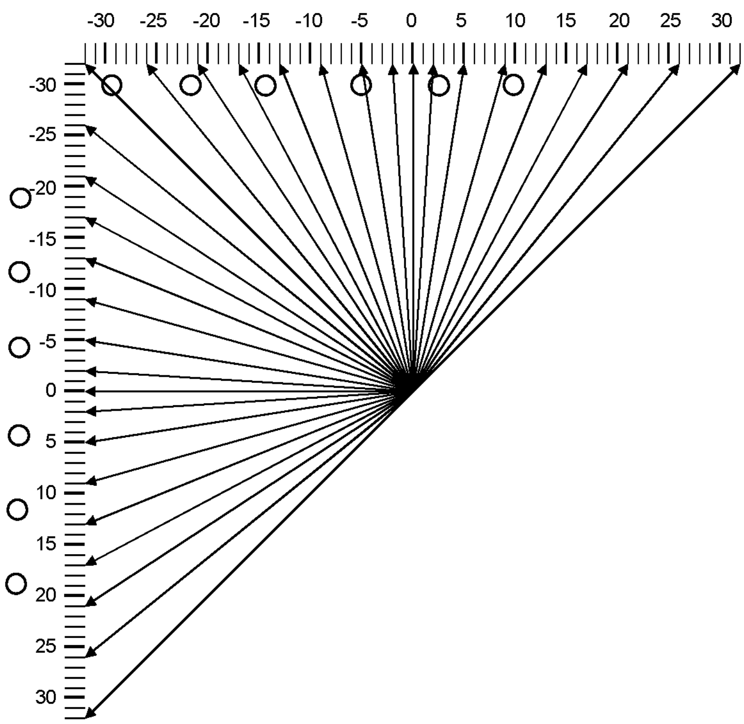
-30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30
-30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30

Fig. 2

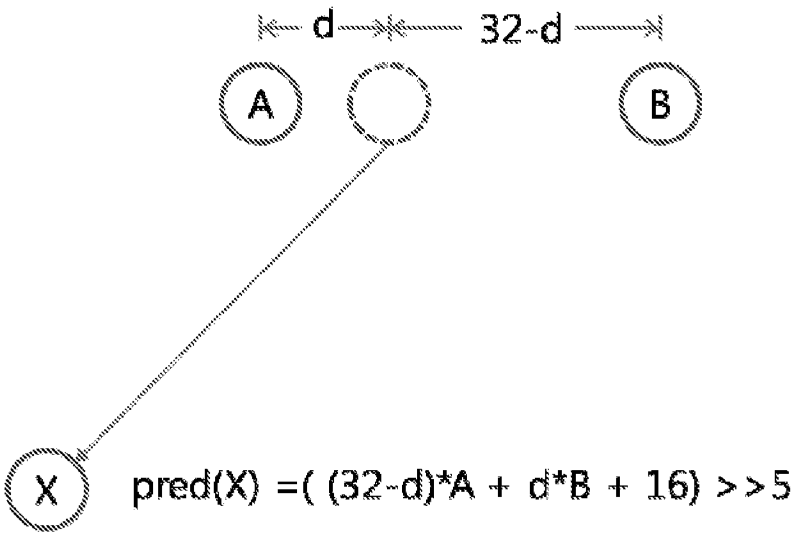
d
32-d
A
B
X
pred(X) =((32-d)*A + d*B + 16) >>5

Fig. 3

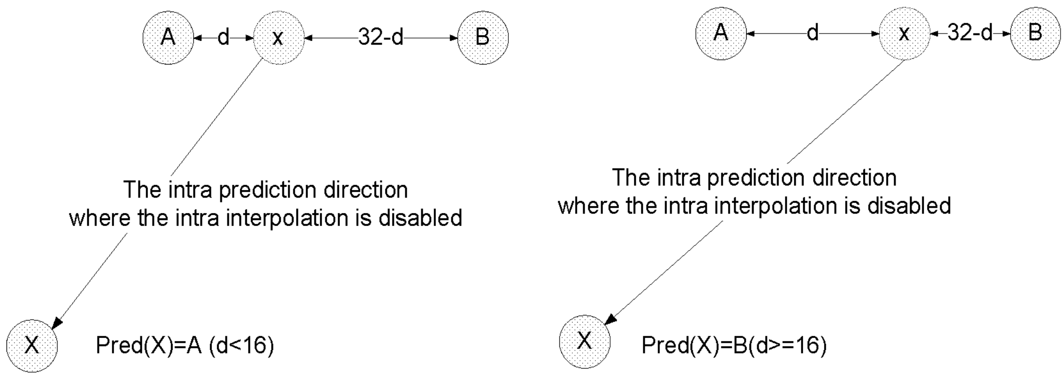
A
d
x
32-d
B
The intra prediction direction
where the intra interpolation is disabled
X
Pred(X)=A (d<16)
A
d
x
32-d
B
The intra prediction direction
where the intra interpolation is disabled
X
Pred(X)=B(d>=16)

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2014/070016

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)

CNABS,CNTXT,VEN:intra,prediction,interpolation,disable,enable,available,unavailable,on,off,not use,video,code,encode, pixel,sample,mediatek

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 1744718 A (MITSUBISHI ELECTRIC CO LTD) 08 March 2006 (2006-03-08) description，page 2，lines 8 to 10，page 4，lines 15 to 19 and figure 2	1-17
A	WO 2011142801 A1 (THOMSON LICENSING) 17 November 2011 (2011-11-17) the whole document	1-17

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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)

"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

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 September 2014	**30 September 2014**

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2014/070016

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 1744718 A	08 March 2006	US 2006093041 A1	04 May 2006
		JP 2006094483 A	06 April 2006
		EP 1696673 A1	30 August 2006
WO 2011142801 A1	17 November 2011	US 2013044814 A1	21 February 2013