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(54) **Title:** METHODS AND APPARATUSES OF INTRA MODE CODING FOR HEVC

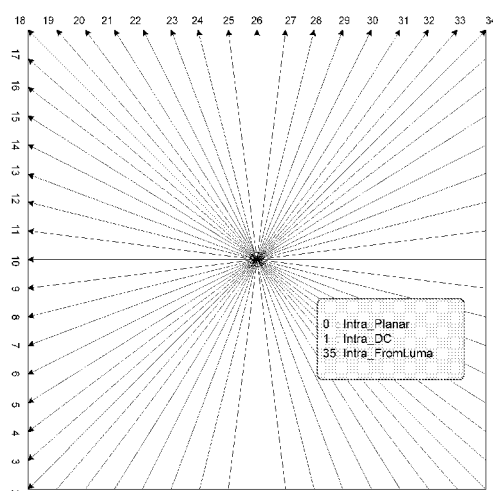


Fig. 1

(57) **Abstract:** Methods of intra mode coding for HEVC is disclosed. The selection of most probable modes in intra mode coding is modified so that it could be much more unified.

5 METHODS AND APPARATUSES OF INTRA MODE

CODING FOR HEVC

TECHNICAL FIELD

[0001] The invention relates generally to video processing. In particular, the present invention relates to methods and apparatuses of intra mode coding for High Efficiency Video Coding (HEVC).
10

BACKGROUND

[0002] HEVC (High Efficiency Video Coding) is an advanced video coding system being developed under the Joint Collaborative Team on Video Coding (JCT-VC) group of video coding experts from ITU-T Study Group. In HEVC test model version 6.0 (HM-6.0), the prediction unit (PU) for intra coding can be 64x64, 32x32, 16x16, 8x8, and 4x4. 35 intra prediction modes, i.e., mode 0 ~ mode 34 in Fig. 1, are used for all PU sizes. Besides, mode 35 (Intra_FromLuma) is only used for chroma component when chroma_pred_from_luma_enabled_flag is equal to 1.
15

[0003] During the intra mode coding of luma component in HM-6.0, three most probable modes (denoted as candModeList[x] with x=0..2) are derived for each luma PU from the intra mode of the neighboring PU on the left of the current PU (denoted as candIntraPredModeA) and the one of the neighboring PU on top of the current PU (denoted as candIntraPredModeB). The candModeList[x] is derived as follows:
20

- If candIntraPredModeB is equal to candIntraPredModeA, the following applies:
- 25 – If candIntraPredModeA is less than 2 (either Intra_Planar or Intra_DC), candModeList[x] with x=0..2 is derived as:

$$\text{candModeList}[0] = \text{Intra_Planar} \quad (1)$$

$$\text{candModeList}[1] = \text{Intra_DC} \quad (2)$$

$$\text{candModeList}[2] = \text{Intra_Angular} (26) \quad (3)$$

- 30 – Otherwise, candModeList[x] with x=0..2 is derived as:

5 $\text{candModeList}[0] = \text{candIntraPredModeA}$ (4)

$\text{candModeList}[1] = 2 + ((\text{candIntraPredModeA} - 2 - 1) \% 32)$ (5)

$\text{candModeList}[2] = 2 + ((\text{candIntraPredModeA} - 2 + 1) \% 32)$ (6)

– Otherwise ($\text{candIntraPredModeB}$ is not equal to $\text{candIntraPredModeA}$), the following applies:

10 – $\text{candModeList}[0]$ and $\text{candModeList}[1]$ are derived as follows:

$\text{candModeList}[0] = \text{candIntraPredModeA}$ (7)

$\text{candModeList}[1] = \text{candIntraPredModeB}$ (8)

– If none of $\text{candModeList}[0]$ and $\text{candModeList}[1]$ is equal to Intra_Planar , $\text{candModeList}[2]$ is set equal to Intra_Planar ,

15 – Otherwise, if none of $\text{candModeList}[0]$ and $\text{candModeList}[1]$ is equal to Intra_DC , $\text{candModeList}[2]$ is set equal to Intra_DC ,

– Otherwise, $\text{candModeList}[2]$ is set equal to Intra_Angular (26).

If the neighboring PU to the left or on top of the current PU is not available or is not intra coded, $\text{candIntraPredModeA}$ or $\text{candIntraPredModeB}$ is set equal to Intra_DC .

20 [0004] If the current intra mode (denoted as IntraPredMode) is equal to any of the most probable modes in candModeList , a flag $\text{prev_intra_pred_flag}$ equal to 1 is transmitted followed by the index of the mode that is identical to IntraPredMode in candModeList ; otherwise, the remaining mode of IntraPredMode (denoted as $\text{rem_intra_luma_pred_mode}$) is transmitted following the flag $\text{prev_intra_pred_flag}$ equal to 0.

[0005] Within the generation of the most probable modes, if $\text{candIntraPredModeB}$ is equal to $\text{candIntraPredModeA}$ and $\text{candIntraPredModeA}$ is not less than 2, $\text{candModeList}[x]$ with $x=0..2$ is derived as Equations (4)~(6). $\text{candModeList}[1]$ and $\text{candModeList}[2]$ corresponding to each possible $\text{candIntraPredModeA}$ are given in Table 1. When $\text{candIntraPredModeA}$ is equal to 33, its upper neighbor $\text{candModeList}[2]$ is mode 2. According to the angles of intra modes, the upper neighbor of mode 33 should be 34, which will be consistent with some other modes except mode 34 (mode 34 has no upper neighbor).

35 Table 1. $\text{candModeList}[1]$ and $\text{candModeList}[2]$ correspond to each possible $\text{candIntraPredModeA}$ if $\text{candIntraPredModeB}$ is equal to $\text{candIntraPredModeA}$ and $\text{candIntraPredModeA}$ is not less than 2.

$\text{candIntraPredModeA}$	2	3	4	5	6	7	8	9	10	11	12
$\text{candModeList}[1]$	33	2	3	4	5	6	7	8	9	10	11
$\text{candModeList}[2]$	3	4	5	6	7	8	9	10	11	12	13
$\text{candIntraPredModeA}$	13	14	15	16	17	18	19	20	21	22	23
$\text{candModeList}[1]$	12	13	14	15	16	17	18	19	20	21	22
$\text{candModeList}[2]$	14	15	16	17	18	19	20	21	22	23	24

candIntraPredModeA	24	25	26	27	28	29	30	31	32	33	34
candModeList[1]	23	24	25	26	27	28	29	30	31	32	33
candModeList[2]	25	26	27	28	29	30	31	32	33	2	3

5

SUMMARY

[0006] In light of the previously described problems, there exists a need for an apparatus and method, in which the selection of most probable modes in intra mode coding will be modified so that it could be much more unified.

BRIEF DESCRIPTION OF DRAWINGS

10

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

[0007] Fig. 1 is a diagram illustrating the intra prediction mode directions.

DETAILED DESCRIPTION

15

[0008] 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.

20

[0009] In the first embodiment, within the generation of the most probable modes, if candIntraPredModeB is equal to candIntraPredModeA and candIntraPredModeA is not less than 2, candModeList[2] is derived as below:

$$\text{candModeList}[2] = 3 + ((\text{candIntraPredModeA} - 2) \% 32). \quad (9)$$

25

Then candModeList[1] and candModeList[2] corresponding to each possible candIntraPredModeA are derived with Equations (4), (5) and (9). They are given in Table 2. When candIntraPredModeA is equal to 33, its upper neighbor candModeList[2] is set to be mode 34.

Table 2. candModeList[1] and candModeList[2] correspond to each possible candIntraPredModeA if candIntraPredModeB is equal to candIntraPredModeA and candIntraPredModeA is not less than 2.

candIntraPredModeA	2	3	4	5	6	7	8	9	10	11	12
candModeList[1]	33	2	3	4	5	6	7	8	9	10	11
candModeList[2]	3	4	5	6	7	8	9	10	11	12	13
candIntraPredModeA	13	14	15	16	17	18	19	20	21	22	23
candModeList[1]	12	13	14	15	16	17	18	19	20	21	22

candModeList[2]	14	15	16	17	18	19	20	21	22	23	24
candIntraPredModeA	24	25	26	27	28	29	30	31	32	33	34
candModeList[1]	23	24	25	26	27	28	29	30	31	32	33
candModeList[2]	25	26	27	28	29	30	31	32	33	34	3

5 [0010]The methods described above can be used in a video encoder as well as in a video decoder. Embodiments of the methods 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.

25 [0011]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 mode coding for video coding, comprising:
determining the most probable modes when candIntraPredModeB is equal to candIntraPredModeA and candIntraPredModeA is not less than 2, that is intra
5 modes of two neighboring blocks are not identical and are neither DC mode nor Planar mode.
2. The method as claimed in claim 1, wherein the most probable modes (i.e., candModeList[x] with $x = 0 \dots 2$) are selected with the following equations:
candModeList[0] = candIntraPredModeA
10 candModeList[1] = $2 + ((\text{candIntraPredModeA} - 2 - 1) \% 32)$
candModeList[2] = $3 + ((\text{candIntraPredModeA} - 2) \% 32)$.
3. The method as claimed in claim 1, wherein an upper neighbor (candModeList[2]) of candIntraPredModeA equal to 33 is set to be mode 34.

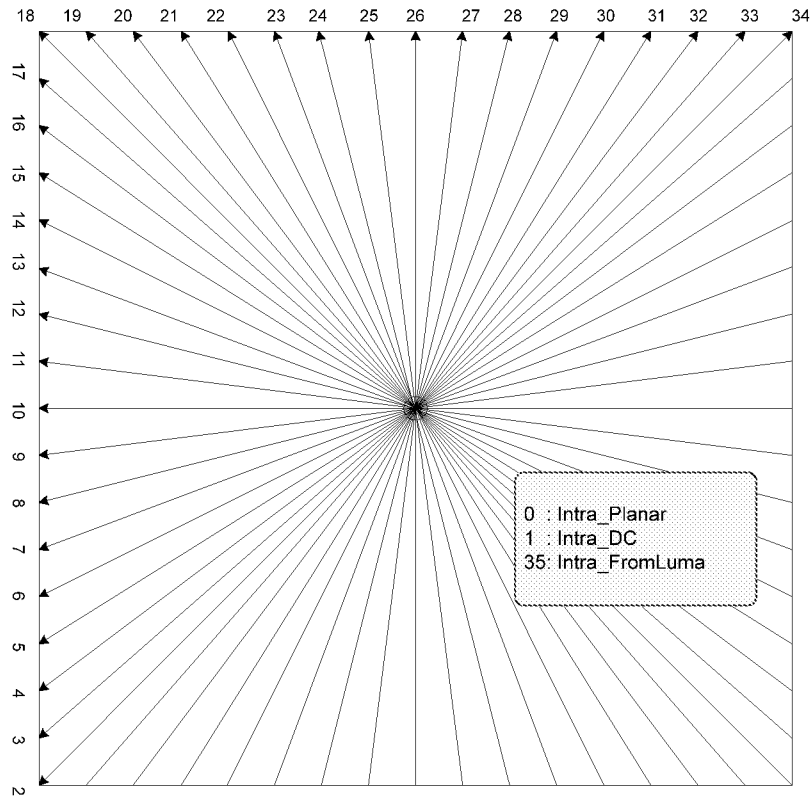


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/074129

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

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: 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; CNKI; VEN; IEEE: high, efficiency, video, coding, HEVC, intra, mode, image???, picture???, cod???, encod???, decod???, most, probable???, select???, candModeList???, candIntraPredMode???

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Thomas Wiegand et al. 'JCTVC-E603: Working Draft 3 of High-Efficiency Video Coding'. In: Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11, 5th Meeting, Geneva, CH, 23 March 2011, pages 92-95	1,3
A	CN1659580A (NOKIA CORP.) 24 Aug. 2005 (24.08.2005) the whole document	1-3
A	CN101228797A (SAMSUNG ELECTRONICS CO., LTD.) 23 July 2008 (23.07.2008) the whole document	1-3

☐ 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
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"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	

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INTERNATIONAL SEARCH REPORT
Information on patent family members

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Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN1659580A	24.08.2005	US2003231795A1	18.12.2003
		MX2004012133A1	01.05.2005
		KR1017094B1	25.02.2011
		MX258304B	30.06.2008
		AU2003240172A1	22.12.2003
		TWI239207B	01.09.2005
		US2008013629A1	17.01.2008
		JP4490261B2	23.06.2010
		WO03105070A1	18.12.2003
		KR20050007607A	19.01.2005
		US2006188165A1	24.08.2006
		RU2314656C2	10.01.2008
		AU2003240172B2	10.09.2009
		JP2005529527T	29.09.2005
		US7289674B2	30.10.2007
		CN100380984C	09.04.2008
		US2004008771A1	15.01.2004
		EP1512115A1	09.03.2005
		TW200407031A	01.05.2004
CN101228797A	23.07.2008	KR20070012168A	25.01.2007
		US2007019726A1	25.01.2007
		EP1905245A1	02.04.2008
		CN101228797B	19.05.2010
		WO2007032600A1	22.03.2007
		KR100678911B1	05.02.2007

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

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