



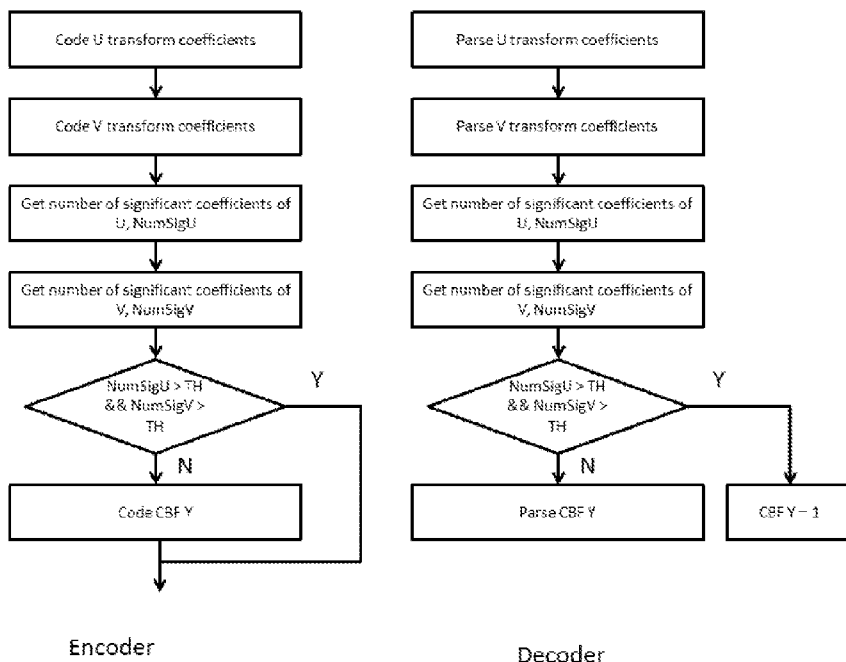
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(54) **Title:** CODED BLOCK FLAG CODING USING CROSS-COMPONENT CORRELATION



(57) **Abstract:** Method for coding of CBF is proposed. CBF signaling for one color component depends on the number of significant coefficients in the other color components.

Fig.1

CODED BLOCK FLAG CODING USING CROSS- COMPONENT CORRELATION

TECHNICAL FIELD

[0001] The invention relates generally to image and video processing. In particular,
5 the presented invention relates to image and video coding.

BACKGROUND

[0002] In a typical hybrid video codec, e.g. H.264 and HEVC, an image block is first intra/inter predicted, and then the residual signal is transform coded. In the
10 transform coding stage, a coded block flag (CBF) is first signaled to indicate the significance of the entire transform block. If CBF is not zero, then the transform coefficients are coded; else, the transform coefficients are inferred to be all zero.

[0003] The CBF flag is usually independently signaled for each color component. A root CBF flag is used to indicate whether transform coefficients of all color components are zero. If root CBF is zero, then the CBF flags and transform
15 coefficients of all color components are inferred to be zero. If root CBF is not zero, then it indicates that at least one CBF flag in one color component is not zero. So, for example, in YUV color format, if root CBF is not zero and CBF flag in U and V components are both zero, then the CBF flag for Y component is not explicitly coded
20 and is inferred to be not zero. However, when U and V components are not both zero, the CBF flag for Y component should always be explicitly signaled.

[0004] When coding the CBF flag, usually arithmetic coding is adopted. Typically the *Context Based Binary Arithmetic Coding* (CABAC) is used.

25

SUMMARY

[0005] Methods of coded block flag (CBF) coding are proposed. In which, CBF signaling for one color component depends on the number of significant coefficients

in the other color components.

[0006] 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.

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BRIEF DESCRIPTION OF DRAWINGS

[0007] The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

10 [0008] Fig. 1 is a diagram illustrating an example of Y component CBF coding depending on the number of significant coefficients in U and V components.

DETAILED DESCRIPTION

15 [0009] 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 [0010] In the proposed methods, CBF signaling for one color component depends on the number of significant coefficients in the other color components. Without loss of generality, the YUV format is used as example in the following description. The same methods can be applied to other formats as well. It also should be noted that the proposed methods can be applied to any transform method or transform skip. In the case of transform skip, the coefficients in a transform block are the quantized residual signal.

25 [0011] For simplicity, let CBF_Y , CBF_U , CBF_V denote the CBF of Y, U and V component, respectively. Also, let $NumSig_Y$, $NumSig_U$, $NumSig_V$ denote the number of significant coefficients in Y, U and V component, respectively.

[0012] In one embodiment, coding of CBF_Y depends on $NumSig_U$ and $NumSig_V$. For examples:

30 1) If $NumSig_U > TH$ && $NumSig_V > TH$, then CBF_Y is not

explicitly coded, and is inferred to be not zero.

- 2) If $NumSig_U > TH \parallel NumSig_V > TH$, then CBF_Y is not explicitly coded, and is inferred to be not zero.
- 3) If $f(NumSig_U, NumSig_V) > TH$, then CBF_Y is not explicitly coded, and is inferred to be not zero. $f()$ is a function of $NumSig_U$ and $NumSig_V$, e.g. $f(NumSig_U, NumSig_V) = NumSig_U + NumSig_V$.

[0013] In still another embodiment, coding of CBF_V depends on the $NumSig_U$.

For examples:

- 1) If $NumSig_U > TH$, then CBF_V is not explicitly coded, and is inferred to be not zero.
- 2) If $f(NumSig_U) > TH$, then CBF_V is not explicitly coded, and is inferred to be not zero. $f()$ is a function of $NumSig_U$

[0014] In still another embodiment, coding of CBF_U depends on the $NumSig_V$.

For examples:

- 1) If $NumSig_V > TH$, then CBF_U is not explicitly coded, and is inferred to be not zero.
- 2) If $f(NumSig_V) > TH$, then CBF_U is not explicitly coded, and is inferred to be not zero. $f()$ is a function of $NumSig_V$

[0015] In still another embodiment, context modeling in coding of CBF_Y depends on $NumSig_U$ and $NumSig_V$. In other words, depending on different values of $NumSig_U$ and $NumSig_V$, different context models are chosen for CABAC coding of CBF_Y . For examples:

- 1) If $NumSig_U > TH \&\& NumSig_V > TH$, use a predefined context model; Else, use other context models.
- 2) If $NumSig_U > TH \parallel NumSig_V > TH$, use a predefined context model; Else, use other context models.
- 3) If $f(NumSig_U, NumSig_V) > TH$, use a predefined context model, Else, use other context models. $f()$ is a function of $NumSig_U$ and $NumSig_V$, e.g. $f(NumSig_U, NumSig_V) = NumSig_U + NumSig_V$.

[0016] In still another embodiment, context modeling in coding of CBF_V depends on the $NumSig_U$. In other words, depending on different values of $NumSig_U$, different context models are chosen to code CBF_V . For examples:

- 1) If $NumSig_U > TH$, use a predefined context model; Else, use other context models.

- 2) If $f(\text{NumSig}_U) > TH$, use a predefined context model; Else, use other context models. $f()$ is a function of NumSig_U .

[0017] In still another embodiment, context modeling in coding of CBF_U depends on the NumSig_V . In other words, depending on different values of NumSig_V ,

5 different context models are chosen to code CBF_U . For examples:

- 1) If $\text{NumSig}_V > TH$, use a predefined context model; Else, use other context models.
- 2) If $f(\text{NumSig}_V) > TH$, use a predefined context model; Else, use other context models. $f()$ is a function of NumSig_V .

10 [0018] The number TH in the above description can be a predefined value in both encoder and decoder or can be signaled to decoder.

[0019] The methods described above can be used in a video encoder as well as in a video decoder. Embodiments of CBF coding according to the present invention as described above may be implemented in various hardware, software codes, or a
15 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
20 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
25 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.

30 [0020] 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 CBF coding, in which CBF signaling for one color component depends on the number of significant coefficients in the other color components.

5 2. The method as claim in claim 1, wherein CBF_Y signaling depends on the number of significant coefficients in U and V components, wherein

1) if $NumSig_U > TH \ \&\& \ NumSig_V > TH$, then CBF_Y is not explicitly coded, and is inferred to be not zero;

2) if $NumSig_U > TH \ \parallel \ NumSig_V > TH$, then CBF_Y is not explicitly coded,
10 and is inferred to be not zero;

3) if $f(NumSig_U, NumSig_V) > TH$, then CBF_Y is not explicitly coded, and is inferred to be not zero; f is a function of $NumSig_U$ and $NumSig_V$, e.g. $f(NumSig_U, NumSig_V) = NumSig_U + NumSig_V$.

3. The method as claimed in claim 1, wherein context modeling in CABAC
15 coding of CBF_Y depends on the $NumSig_U$ and $NumSig_V$, wherein

1) $NumSig_U > TH \ \&\& \ NumSig_V > TH$, use a predefined context model; Else, use other context models;

2) $NumSig_U > TH \ \parallel \ NumSig_V > TH$, use a predefined context model; Else, use other context models;

20 3) If $f(NumSig_U, NumSig_V) > TH$, use a predefined context model, Else, use other context models; f() is a function of $NumSig_U$ and $NumSig_V$, e.g. $f(NumSig_U, NumSig_V) = NumSig_U + NumSig_V$.

4. The method as claim in claim 1, wherein CBF_V signaling depends on the number of significant coefficients in U component, wherein

25 1) if $NumSig_U > TH$, then CBF_V is not explicitly coded, and is inferred to be not zero;

2) if $NumSig_U > TH$, then CBF_V is not explicitly coded, and is inferred to be not zero;

3) if $f(NumSig_U) > TH$, then CBF_V is not explicitly coded, and is inferred to
30 be not zero; f is a function of $NumSig_U$.

5. The method as claim in claim 1, wherein CBF_U signaling depends on the number of significant coefficients in V component, wherein

1) if $NumSig_V > TH$, then CBF_U is not explicitly coded, and is inferred to be

not zero;

2) if $NumSig_V > TH$, then CBF_U is not explicitly coded, and is inferred to be not zero;

3) if $f(NumSig_V) > TH$, then CBF_U is not explicitly coded, and is inferred to be not zero; f is a function of $NumSig_V$.

6. The method as claimed in claim 1, wherein context modeling in CABAC coding of CBF_V depends on the $NumSig_U$, wherein

1) $NumSig_U > TH$, use a predefined context model; Else, use other context models;

2) If $f(NumSig_U) > TH$, use a predefined context model, Else, use other context models; $f()$ is a function of $NumSig_U$.

7. The method as claimed in claim 1, wherein context modeling in CABAC coding of CBF_U depends on the $NumSig_V$, wherein

1) $NumSig_V > TH$, use a predefined context model; Else, use other context models;

2) If $f(NumSig_V) > TH$, use a predefined context model, Else, use other context models; $f()$ is a function of $NumSig_V$.

8. The method as claimed in claim 2~ claim 7, the value TH can be predefined at both encoder and decoder.

9. The method as claimed in claim 2~ claim 7, the value TH can be coded at sequence level, view level, picture level, slice level, or other levels.

10. The method as claimed in claim 1, wherein one or more syntax elements can be used to signal whether the proposed CBF coding method is used; the syntax element can be coded.

11. The method as claimed in claim 10, wherein the syntax elements can be explicitly transmitted in the sequence level, view level, picture level, slice level, or other levels; for example, it can be coded in VPS, SPS, PPS, APS, slice header, LCU *et al.*

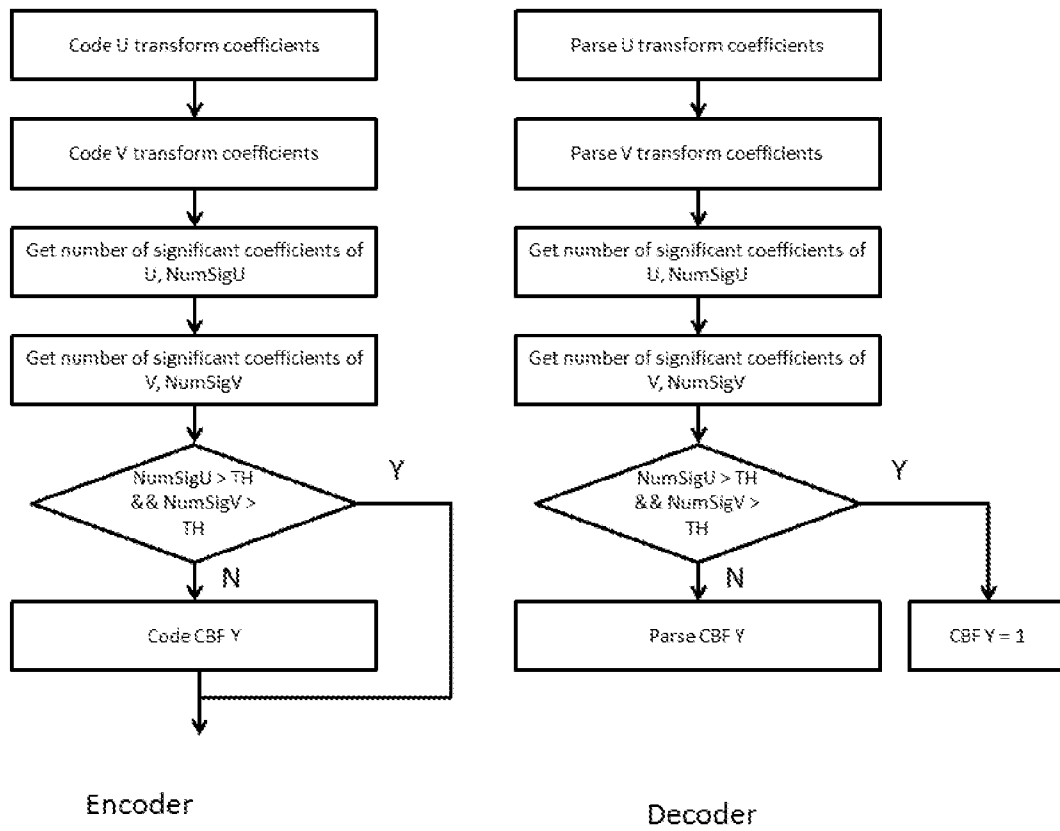


Fig.1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/079350

A. CLASSIFICATION OF SUBJECT MATTER

H04N 19/13(2014.01)i; H04N 19/134(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, G06F

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: CBF, coded block flag, YUV, coefficient, signal+, color component

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 103583048 A (PANASONIC CORPORATION) 12 February 2014 (2014-02-12) paragraphs[0429]-[0452]	1, 10, 11
A	CN 104471934 A (SAMSUNG ELECTRONICS CO., LTD.) 25 March 2015 (2015-03-25) the whole document	1-11
A	CN 103227917 A (HUAWEI TECHNOLOGIES CO., LTD. ET AL.) 31 July 2013 (2013-07-31) the whole document	1-11
A	WO 2013142784 A2 (QUALCOMM INCORPORATED) 26 September 2013 (2013-09-26) the whole document	1-11

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

* Special categories of cited documents:

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“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

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2015/079350

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