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(54) Title: METHODS FOR MOTION VECTOR STORAGE IN VIDEO CODING

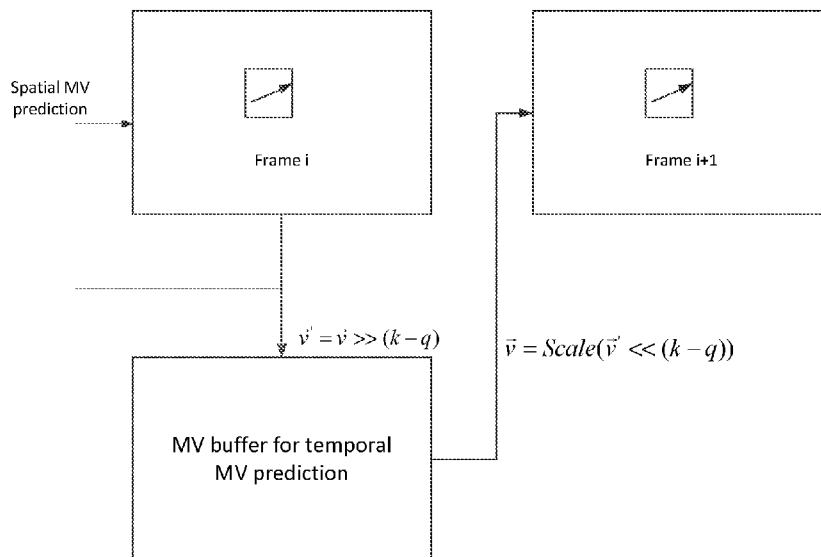


Fig.2

(57) Abstract: Methods for motion vector storage are proposed. The motion vector resolution is reduced for temporal motion vector prediction.

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METHODS FOR MOTION VECTOR STORAGE IN VIDEO CODING

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention relates generally to video processing. In particular, the present invention relates to methods for motion vector storage in video coding and its extensions, 3D video coding, scalable video coding, screen content coding et al.

Description of the Related Art

[0002] In general video coding, block based motion compensation is used for inter prediction. The displacement between current block and reference block is defined as motion vector (MV). For efficient signaling of MV, motion vector prediction is usually adopted in a typical video codec. There're two types of motion vector prediction. One is spatial motion vector prediction in which the MV of spatially neighboring coded MV is used for predicting the MV at current block. The other is temporal motion vector prediction, in which the coded MV at previous frame is used to predict MV at current block. In the case of temporal motion vector prediction, the MVs of all inter coded blocks in the reference frame need to be stored in a buffer, as shown in Fig. 1, then the scaled MV, according the temporal position of frame $i+1$, frame i and the reference frame of frame i , is used for prediction.

[0003] Let $minBlkW$ and $minBlkH$ be the minimum block width and minimum block height of a inter prediction block. Then the maximum number of MVs that needed to be stored is $(picWidth / minBlkW) * (picHeight / minBlkH)$, where $picWidth$ and $picHeight$ are the width and height of a coded picture, respectively.

[0004] In order to reduce storage, motion vector “compression” can be used, by which only one MV is stored for each MxN block ($M > \text{minBlkW}$, $N > \text{minBlkH}$). In the case of multiple MVs in an MxN block, we can simply select the MV at top-left sub-block. In this way, the motion vector field is sub-sampled, therefore the storage is reduced.

[0005] In HEVC, the MV resolution is $\frac{1}{4}$ pixel accuracy. In recent development of next generation video coding, the MV resolution can be $\frac{1}{8}$, $\frac{1}{16}$ or even higher. So the storage of MV is also increased. One solution is to reduce the range of MV so that the same number of bits can be used to represent a MV. However, this will degrade the performance of motion compensation prediction in the case of fast motion scenario. To solve this problem, method for MV storage is proposed.

BRIEF SUMMARY OF THE INVENTION

[0006] Methods of motion vector storage are proposed. It is proposed that the resolution of MV that is stored in the buffer for temporal motion vector prediction is lower than the resolution of MV that is used for motion compensation.

[0007] 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

[0008] The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

[0009] Fig.1 is a diagram illustrating the concept of temporal motion vector prediction.

[0010] Fig.2 is a diagram illustrating the concept of proposed method.

DETAILED DESCRIPTION OF THE INVENTION

[0011] 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.

[0012] Let $\vec{v} = (v_x, v_y)$ denote a MV that is used for inter prediction. Its resolution is $\frac{1}{2^k}$, k can be 2, 3, 4, and so on. In other words, the basic unit of v_x, v_y is $\frac{1}{2^k}$ pixel. After a frame is coded, all the MVs are stored in a MV buffer for temporal motion vector prediction.

[0013] In the proposed method, as shown in Fig. 2, the MVs are modified to a predefined resolution $\frac{1}{2^q}$ before stored in the MV buffer. And q is smaller than k , which means that the MVs stored in the buffer have lower resolution.

[0014] In one embodiment, $\vec{v}' = (v_x', v_y')$ is stored in the MV buffer, where, $v_x' = v_x \gg (k - q), v_y' = v_y \gg (k - q)$. When used for temporal MV prediction, the MV is modified to original resolution before scaling, i.e. $\vec{v}' = \vec{v}' \ll (k - q)$.

[0015] In another embodiment, $\vec{v}' = (v_x', v_y')$ is stored in the MV buffer, where, $o = 1 \ll (k - q - 1), v_x' = (v_x + o) \gg (k - q), v_y' = (v_y + o) \gg (k - q)$. When used for temporal MV prediction, the MV is modified to original resolution before scaling, i.e. $\vec{v}' = \vec{v}' \ll (k - q)$.

[0016] In still another embodiment, the value of $d=k-q$ is signaled from encoder to decoder.

[0017] In still another embodiment, the value d can be signaled at video parameter

set, picture parameter set, sequence parameter set, et cl.

[0018] In still another embodiment, the value d can be signaled at slice header, so that each slice can have different d , therefore different resolution of MV in the buffer.

[0019] There are some cases that the resolution of MV used for motion compensation can be different from the resolution of MV used for spatial motion vector prediction. For example, in the case of affine motion compensation, the MV used for motion compensation of each sub-block can be $1/16$, $1/64$ or even higher. However, the resolution of MV that used for motion vector prediction at following blocks is of $1/8$. In these cases, the derived MV is first modified to resolution $1/8$ for spatial motion vector prediction, and then further modified to resolution $1/4$ before stored in the MV buffer for temporal motion vector prediction.

[0020] The proposed methods described above can be used in a video encoder as well as in a video decoder. Embodiments of the proposed 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.

[0021] 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.

What is claimed is

1. A method of motion vector storage, by which the resolution of motion vector is reduced before storing in a MV buffer for temporal motion vector prediction. Let $\vec{v} = (v_x, v_y)$ denote a MV that is used for inter prediction. Its resolution is $\frac{1}{2^k}$, k can be any integers such as 0, 1, 2, 3, 4, and so on. Instead of \vec{v} ,

$\vec{v}' = (v'_x, v'_y)$ is stored in the MV buffer, of which resolution is $\frac{1}{2^q}$, where q is not equal to k.

2. The method as claimed in claim 1, wherein $q < k$.

3. The method as claimed in claim 1, wherein $v'_x = (v_x + off_x) \gg (k - q)$, $v'_y = (v_y + off_y) \gg (k - q)$, where off_x and off_y are two integers. When used for temporal MV prediction, the MV is modified to original resolution, i.e. $\vec{v} = \vec{v}' \ll (k - q)$.

4. The method as claimed in claim 3, wherein $off_x = 1 \ll (k - q - 1)$ and $off_y = 1 \ll (k - q - 1)$.

5. The method as claimed in claim 3, $off_x = 0$ and $off_y = 0$.

6. The method as claimed in claim 1, the information of resolution of stored MV used in temporal motion prediction is signaled from encoder to decoder.

7. The method as claimed in claim 6, the information of resolution of stored MV used in temporal motion prediction can be signaled at sequence level, picture level, slice level or block level.

8. The method as claimed in claim 7, the information of resolution of stored MV used in temporal motion prediction can be signaled at video parameter set (VPS), sequence parameter set (SPS), picture parameter set (PPS), slice header (SH),

coding tree unit (CTU), coding unit (CU).

9. The method as claimed in claim 8, the information of resolution of stored MV of the current slice used in temporal motion prediction for succeeding slices can be signaled in the current slice.

10. The method as claimed in claim 8, the information of resolution of stored MV of the current slice used in temporal motion prediction for succeeding slices can be signaled in the succeeding slices.

11. The method as claimed in claim 8, the MV resolution of temporal motion prediction for the current slice can be signaled in the current slice.

12. The method as claimed in claim 6, the value of $d=k-q$ is signaled from encoder to decoder.

13. The method as claimed in claim 1, in some blocks the resolution of MV used for motion compensation can be $\frac{1}{2^p}$, $p > k$, but the resolution of MV used for spatial motion vector prediction is $\frac{1}{2^k}$, and the resolution of MV used for temporal motion vector prediction is $\frac{1}{2^q}$. In other words, in those cases MV is first modified to the resolution of $\frac{1}{2^k}$ for spatial motion vector prediction, and then further modified to the resolution of $\frac{1}{2^q}$ before store in the buffer for temporal motion vector prediction.

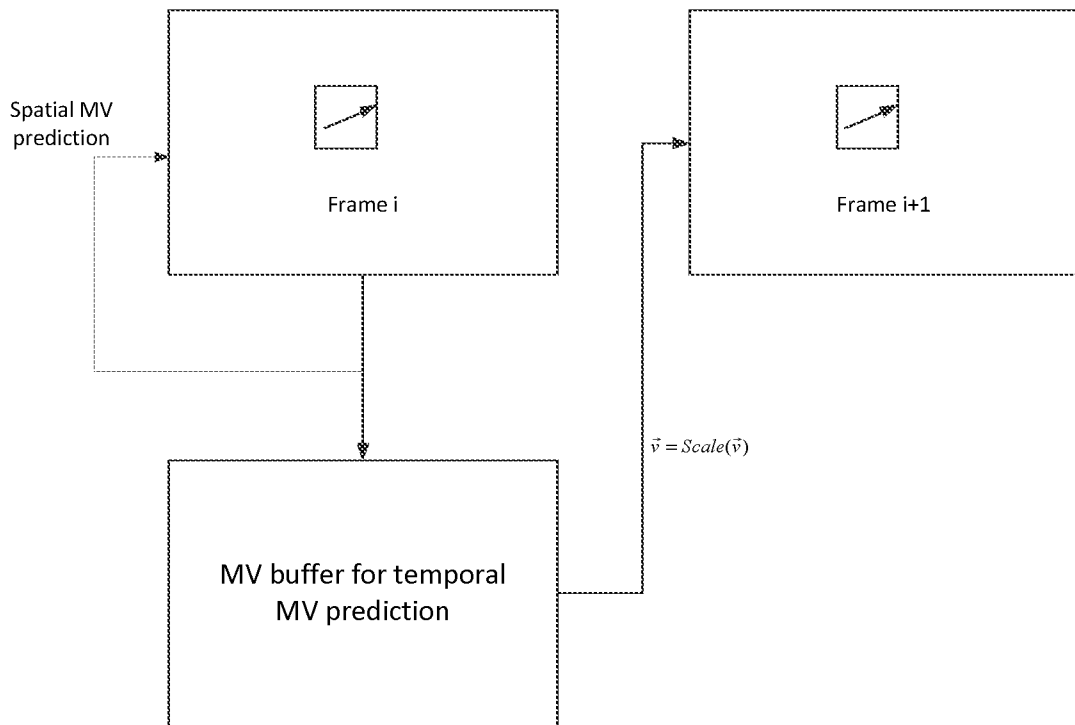


Fig. 1

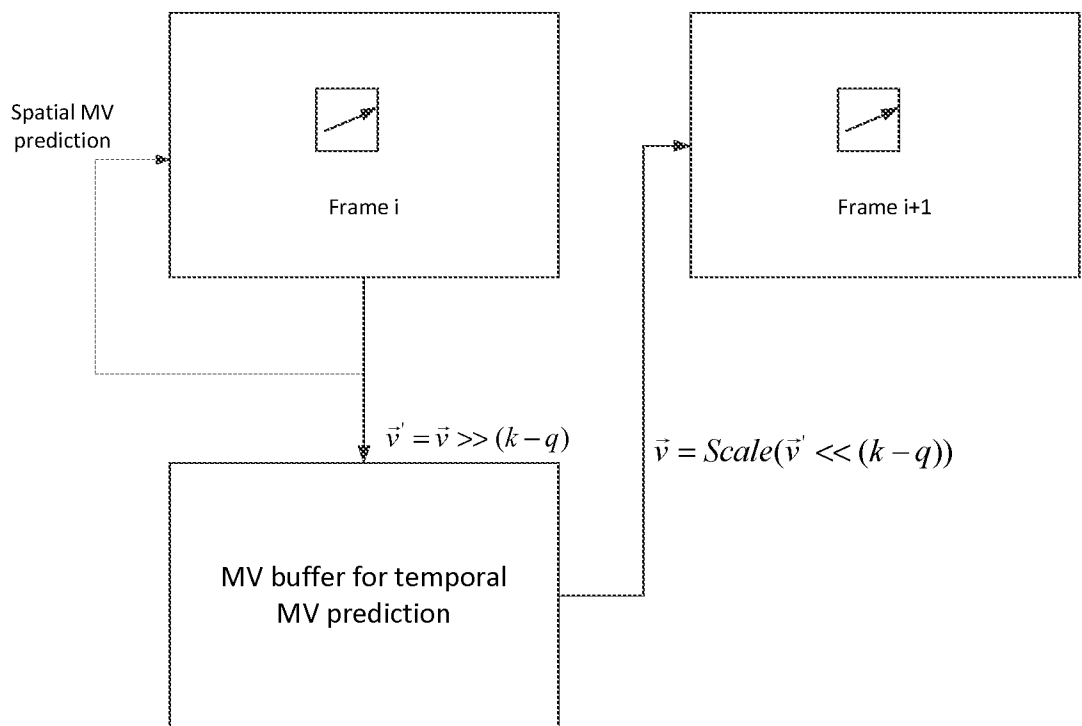


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/076224

A. CLASSIFICATION OF SUBJECT MATTER		
H04N 19/513(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)		
WPI,EPODOC,CNPAT,CNKI: HEVC, motion, vector, resolution, precision, definition, reduce, decrease, storage, storing, buffer, memory, temporal, inter, prediction, time, shift, replacement, rounding, excursion, offset, truncation, intercept, full-pixel, sub-pixel		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 104335586 A (QUALCOMM INCORPORATED) 04 February 2015 (2015-02-04) description, paragraphs [0033]-[0036], [0052], [0106], [0174] and [0175]	1-13
A	US 2011170595 A1 (SHI, XUN ET AL.) 14 July 2011 (2011-07-14) the whole document	1-13
A	WO 2015105816 A2 (MICROSOFT TECHNOLOGY LICENSING, LLC) 16 July 2015 (2015-07-16) the whole document	1-13
A	CN 102783149 A (QUALCOMM INCORPORATED) 14 November 2012 (2012-11-14) the whole document	1-13
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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	“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
“E”	earlier application or patent but published on or after the international filing date	“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
“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)	“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
“O”	document referring to an oral disclosure, use, exhibition or other means	“&” document member of the same patent family
“P”	document published prior to the international filing date but later than the priority date claimed	
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Name and mailing address of the ISA/CN		Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/076224

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	104335586	A	04 February 2015	US	2013272410	A1	17 October 2013
				WO	2013155267	A2	17 October 2013
				KR	20150008394	A	22 January 2015
				EP	2837191	A2	18 February 2015
US	2011170595	A1	14 July 2011	None			
WO	2015105816	A2	16 July 2015	US	2015195527	A1	09 July 2015
CN	102783149	A	14 November 2012	US	2011206125	A1	25 August 2011
				WO	2011103206	A1	25 August 2011
				TW	201218774	A	01 May 2012
				KR	20120126108	A	20 November 2012
				EP	2537341	A1	26 December 2012
				JP	2013520875	A	06 June 2013
				JP	2015156653	A	27 August 2015
				IN	201201910	P3	20 December 2013